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Wensong Hu
Editor

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Preface

This book contains papers selected from more than 360 contributions presented during 2012 2nd International Conference on Electric and Electronics (EEIC 2012) held on April 21–22, Sanya, China.

2011 1st EEIC was successfully held on June 20–22, 2011, Nanchang, China. The participants decided to repeat such conferences each year. The basic idea was to establish a periodical international forum presenting multiscale approaches in electric and electronics.

Electronics is the branch of science, engineering and technology that deals with electrical circuits involving active electrical components such as vacuum tubes, transistors, diodes and integrated circuits, and associated passive interconnection technologies. The nonlinear behavior of active components and their ability to control electron flows makes amplification of weak signals possible and is usually applied to information and signal processing. Similarly, the ability of electronic devices to act as switches makes digital information processing possible. Interconnection technologies such as circuit boards, electronics packaging technology, and other varied forms of communication infrastructure complete circuit functionality and transform the mixed components into a working system.

Electronics is distinct from electrical and electro-mechanical science and technology, which deals with the generation, distribution, switching, storage and conversion of electrical energy to and from other energy forms using wires, motors, generators, batteries, switches, relays, transformers, resistors and other passive components. This distinction started around 1906 with the invention by Lee De Forest of the triode, which made electrical amplification of weak radio signals and audio signals possible with a non-mechanical device. Until 1950 this field was called “radio technology” because its principal application was the design and theory of radio transmitters, receivers and vacuum tubes.

Today, most electronic devices use semiconductor components to perform electron control. The study of semiconductor devices and related technology is considered a branch of solid state physics, whereas the design and construction of electronic circuits to solve practical problems come under electronics engineering. This article focuses on engineering aspects of electronics.

The conference EEIC 2012 has been successfully carried on the tradition of previous conference. It is my pleasure to thank the editorial board for the readiness to publish this book devoted to EEIC 2012. I would also thank all members of the Organizing Committee, members of the International Advisory Board, session chairpersons as well as many colleagues who helped with the preparation of the conference and, particularly, with the preparation of the proceedings.

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A Memory Complexity Model for Circular Sentences

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Abstract. The memory system has become a key factor to get high performance, especially for those numerical programs. Along with the increasing gap between processors and memories, the traditional calculation complexity analysis is now not sufficient to judge an algorithm or program. The memory complexity also plays an important role. In this paper, a model based on the memory hierarchy technology was proposed to analyze the memory complexity for circular sentences, which are normally the most time-consuming part for numerical programs, and therefore to judge and predict its performance.

Keywords: Memory complexity, Circular sentence, Memory hierarchy, Model.

1 Introduction

Today, the processors faster and faster, while memory speed has not get a corresponding increase,this worsening the imbalance between the two. To compensate the difference between the two speeds, it uses a lot of complicated hardware technology, the most typical adopt a multi-level storage structure, the introduction of instruction and data cache. This design is based on the temporal locality and the spatial locality of program execution. In order to improve the performance of the cache, the software also uses a lot of optimization techniques appropriate to meet the hardware structure. Programming optimization technique is made by changing the data access in order to maximize data reuse rate, especially in the numerical calculation program, using more widely. Tiling technique with loop transformation is common, block, makes data access to the water or to the compiler optimization of resources to provide more loop unrolling and to reduce memory bank conflicts and cache array Padding mapping techniques. The use of these technologies making an algorithm presented in the same computing platform to achieve a different form. Algorithm merits depends on the complexity of the algorithm. Complexity of the algorithm includes not only the computational complexity, but also have a storage complexity. Different implementations of an algorithm will have the same computational complexity but have different storage complexity, leading to the final performance difference. Storage complexity is often the decision algorithm to achieve the ultimate decisive factor in performance.

This article focuses on the performance difference of the cycle structure because of the storage complexity. This is because the cycle structure is now accounted for a large proportion in algorithm, loop structure is often the most time-consuming algorithm part, and the cycle structure of repeated access to large amounts of data storage due to the complexity of the final performance is the decisive process factors.

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For the realization of the algorithm has a number of different evaluation methods, the most commonly used is the number of floating-point operations per data access analysis. In this paper, we try to proceed from the hardware structure, create a simple storage model. the same data access based on the number of floating-point operations, for a cyclic structure based on different implementations of the algorithm given in the form of a matching hardware and performance evaluation. Some evaluation methods have been proposed, but this method is more simple and effective. On the one hand,we approximately simulate the execution time curve of loop structure algorithm,on the other hand,we give simple and effective determination method to advantages and disadvantages of different implementations of a method.

2 Model Proposed

To make up for the speed difference between CPU and main memory, the memory carry out data exchange with multi-level storage mode, is usually divided into: Register→L1→L2→main memory→disk.The speed and capacity of different levels vary widely:

	Register	L1	L2	main memory	disk
Capacity	32	16KB-128KB	128KB-4MB	Hundreds MB-GB	Virtual
Access time	About equal to 0	Several clock cycles	Ten clock cycles	Dozens of clock cycles	Thousands of clock cycles

In this paper we only consider the data exchange between cache and main memory, because the amount of data exchange of is the largest part and time in data access time is the most. On the memory behavior and the body of the loop algorithm,we can get the following definition:

Definition 1. Data access is the process that the operation read from main memory into the cache,then back into the main memory (the sequence back into the main memory and the read cache is not necessarily the same order).

Definition 2. top loop is the innermost layer.

Definition 3. The loop size of layer i is above the scale of i (including i layer), the sum of all access data size (without double counting),use the floating-point number as unit.

And make the following assumptions:

Assumption 1: Ignore registers,L1 cache access time, only consider the two-tier storage structures, that is, cache (as L2) and the main memory.

Assumption 2: Each time data is read from main memory is regarded as a data access,and each time get the same data access time (ignoring continuous access and non-continuous access). Set a specific memory access time of a single as a constant value t.

Assuming 3: Every time when Access main memory, from the operation of the data address,we continuous operate floating point of constant c For example, read from main memory into A [0] (sequence deposited in the floating-point group) to the cache, from A [0] to A [c - 1] All data will be read into the cache. Thus, if continuous operate A [0] to A [c-1], as long as access main memory one time.

Assuming 4: If i layer circulation is smaller than the cache memory size, then the the working set of cycles of i layer in the i +1 level loop, remains resident in the cache, you do not need to re-read from the main memory, and can take directly action. Otherwise, i layer need to re-cycle all the data from main memory access.

Assuming 5: Per floating-point operations (addition, subtraction, multiplication, division, etc.) use the same time, is a constant u.

Based on the above five assumptions, we establish the following loop structure storage complexity model:

Designed capacity of the cache L2 (floating point number), i-layer loop cycles as Ni, which involves floating-point number stored as the scale of Vi, data access times as Ri, and repeat data visits of all layers above i layer is Si. There: If Vi-1 <L2, then Ri = Ni Ri-1 - Si; if Vi-1> = L2, then Ri = Ni Ri-1. If the cycle has M layers, the total time for data access is RMt. Suppose the floating-point operations per data access of a program is m, then the total execution time T = RMt + mu.

The above model gives a expression of the total executive time of specific code, it is divided into computation time and data access time, corresponding to the computational complexity and storage complexity. For computation time, This article does not carry out in-depth analysis, assuming that it has little influence to the total time. For data access time, it is closely related to memory and processor parameters, which are the embodiment of our departure from the hardware structure of the original intention of seeking a suitable algorithm. Based on the above model, we can simulation and prediction the execution time of loop code on different computing platforms.

3 Example Shows

The model made a great extent simplification on the storage behavior, first, we need to verify the reliability of it, and convinced that the model results of the implementation of the loop code can be more accurate simulation. We copy the matrix, for example, use the following two codes:

```
Variable declaration:
float mxp1[line][row],mxp2[line][row];
int i1,i2;
Code 1:
for(i1=0;i1<line;i1++)
    for(i2=0;i2<row;i2++)
        mxp2[i1][i2]=(mxp1[i1][i2]);
Code 2:
for(i1=0;i1<row;i1++)
  for(i2=0;i2<line;i2++)
        mxp2[i2][i1]=(mxp1[i2][i1]);
```

Code 1 is read by row order, and code 2 is read by the data column order. We know that in the memory matrix is stored row by row, so the code to read data 1 is continuous, and the code 2 is not

Two code memory size of each cycle (of which line=row=n) :

Loop size	V1	V2
Code 1	2n	2n2
Code 2	2nc	2n2

According to the relations between the scale of each cycle Vi and Cache capacity L2, we can obtain Reads of the each data Ri :

Code 1	R1	R2
V1>=L2	2n/c	$2n^2/c$
V1<L2	2n/c	$2n^2/c$

code 2	R1	R2
V1>=L2	2n	2n
V1<L2	2n	$2n^2/c$

We chose the following environmental to test: PIII EB 800Mhz Processor, L2＝256KB , c=8 , cache line=32B, Memory frequency 133Mhz, tRAS=7clock, tRP=3clock, data storage time t=140ns;operating system is Redhat 7.3, compiler is GNU C , using optimization options -o3-funroll-loops-fexpensive-optimizations. Ignore the time of assignment, based on the model, to the different sizes of matrix (different n values), we can get the data access time of the cycle, is the total execution time.

4 Model Application

Analysis of numerical calculation program using the mode can direct the way for the specific store-level performance optimization (data access time spent is relatively small.) To different code for the same algorithms, numerical computation is basically the same cost, that is to reduce data access time, the code execution time is reduced. Today, the processor operations performance Increasing faster, but the memory speed has not be improved fast,it is undoubtedly very important to the people who engaged in the numerical programming.

Matrix operations, in particularly matrix multiplication is One of the most common operations in Numerical calculation, here we give an example for searching the optimum code for matrix multiplication algorithm using cycle storage model.

The following two codes:

```
float mxp1[line][row], mxp2[line][row], mxp3[line][row], tmp1;
int i1, i2;
code 3:
for(i1=0;i1<line;i1++)
{ for(i2=0;i2<row;i2++) { tmp1=0; for(i3=0;i3<line;i3++)
  tmp1=tmp1+mxp1[i1][i3]*mxp2[i3][i2];
  mxp3[i1][i2]=tmp1;
  }
 }
code 4:
for(i1=0;i1<line;i1+=blockwidth)
 { for(i2=0;i2<row;i2+=blockwidth)
   {for(i3=0;i3<line;i3++)
     {for(i4=i1;i4<((i1+blockwidth)<line?(i1+block width):line);i4++)
       {tmp1=0;
        for(i5=i2;i5<((i2+blockwidth)<line?(i2
  +blockwidth):line);i5++)
  tmp1=tmp1+mxp1[i3][i5]*mxp2[i5][i4];
  mxp3[i3][i4]+=tmp1;
 }
 }
    }
  }
```

Code 3 using the most natural approach, each row of mxp2 and each column of mxp1 corresponds unit to multiply and sum, then put it into the appropriate cell of mxp3, code 4 is the block matrix multiplication, the matrix is divided into several pieces by the size of blockwidth × blockwidth, each row of mxp2 and each column of mxp1 corresponds unit of each block multiply, and add to the corresponding unit of mxp3. According to the model, we will analysis the data access time of two codes.

To code 3, by the size of the definition of the cycle,we can get:

Loop size Vi	i=1	i=2	i=3
code 3	nc+n	n2+2n	n2+2n

According to relationship between the scale of each cycle Vi and cache capacity L2,we can get data reads of each Layer Ri:

code 3	R1	R2	R3
V1>L2	n+n/c	n2+n2/c+n/c	n3+n3/c+n2/c
V1<L2<V2	n+n/c	n2/c+2n/c	n3/c+2n2/c
V2<L2	n+n/c	n2/c+2n/c	3n2/c

To code 4,by the definition of the loop size(assume b <n, and c can divides b, and n), we can get:

Vi	i=1	i=2	i=3	i=4	i=5
code 4	bc+b	2b+b2	2bn+ b2	n2+2bn	3n2

The same calculation, we can get data reads of each layer Ri:

code 4	R1	R2	R3
V1>L2	b+b/c	b2+b2/c+b/c	b2n+b2n/c+bn/c
V1<L2<V2	b+b/c	b2/c+2b/c	nb2/c+2bn/c
V2<L2<V3	b+b/c	b2/c +2b/c	b2/c+2bn/c
V3<L2<V4	b+b/c	b2/c+2b/c	b2/c+2bn/c
V4<L2	b+b/c	b2/c+2b/c	b2/c+2bn/

code 4	R4	R5
V1>L2	bn2+bn2/c+n2/c	n3+n3/c+n3/bc
V1<L2<V2	bn2/c+2n2/c	n3/c+2n3/bc
V2<L2<V3	bn/c+2n2/c	n2/c +n3/cb +n3/b2
V3<L2<V4	bn/c+2n2/c	n2/c+2n3/bc
V4<L2	n2/c+2nb/c	3n2/c

Thus, the total data access time of the two pieces of code T1 is respectively for R3t and R5t.

5 Conclusion

In this paper, we discuss the achieve difference of loop structure on different platform, and gives a evaluation model for the realization of the loop complexity.we verify the accuracy of the model through the examples of the matrix eplication. And gives examples using the model for a specific hardware platform for the block matrix multiplication to achieve the best. Overall, the model simulation results and experimental results are consistent, which has significance in the static analysis algorithm. And when the model parameters have a more accurate measurement of the circumstances,we can make more accurate forecasts of the execution time for the process and procedures of the relative performance.

On the model,the following problems need attention:

1. The best difference of simulated values and actual values of the maximum is simulated values ignored the continuity of data update in the cache, that is the simulation curve is piecewise discontinuous, it is not possible to completely simulate the experimental curve, but the trends and values in the curve can be be good estimated.
2. The model can make similar assumptions on L1, L3, and other storage levels, the model may be more accurate, and can improve the discontinuity of the model results, but this Increasing computational and the model is complicated.

The direction of our future work are:

1. The two storage structures expand to more realistic multi-level storage structure, and development software calculated automatically according to the model complexity of a particular access code;

2. The model shoud be extended to The field of parallel computer, especially for multi-core processors, to explore The complexity of loop structure of parallel numerical calculation program;

3. From the loop structure to achieve more program structure, the performance Memory complexity of the code performance will be discussed deeply and widely.

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Summer Hypoxia Off the Changjiang Estuary

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Abstract. An interdisciplinary survey was carried out off the Changjiang (Yangtze River) Estuary from August 27 to September 2, 2009. Salinity, temperature, dissolved oxygen (DO), and chlorophyll-a were measured with a CTD (SBE 19 plus) multi-sensor system. The characteristics of DO distribution was affected by the Chlorophyll-a in the surface, and was affected mainly by stratification in the water 10m beneath the surface. The minimum DO recorded in this survey was down to 1.02 mg/L. The area, water thickness and AOU (Apparent Oxygen Utilization) of hypoxia zone was 3735 km^2, 23.6m and 0.49×10^6t respectively. Strong relationship between stratification variable (PEAP) and hypoxia is demonstrated.

Keywords: Summer hypoxia, AOU, river plume, PEAP, Changjiang Estuary.

1 Introduction

During the recent three decades, the area off the Changjiang(Yangtze River) Estuary has been receiving high loadings of nutrients and sewage from the Changjiang River delta zone due to the rapid growth of economy and developments of urbanization. The nitrate concentration in the Changjiang Estuary has been increased from 20.5 μmol/L in the 1960s to 59.1 μmol/L in the 1980s, and to 80.6 μmol/L in 1990-2004 [1]. The phosphate concentration increased 30%, from 0.59 μmol/L in the 1980s to 0.77 μmol/L in 1990-2004 [1]. Eutrophication caused by increased nutrient input from the Changjiang has been a serious environmental problem after 1985 off the Changjiang Estuary [2]. Events of high chlorophyll-a concentration exceeding 10 mg/m^3 occured frequently in summer[3,4].

Nutrients discharging from the Changjiang make the offshore area off the Estuary as a high primary production area. The famous Zhoushan, Changjiang Estuary, Zhouwai and Jiangwai fishing grounds are located off the Changjiang Estuary. Eutrophication could result in dissolved oxygen (DO) depletion through decomposition of elevated organic matter from enhanced primary production [5], and result in high mortality of fish and other economic marine organisms. Same as the estuary of Mississippi River, Pearl River and other river-dominated ocean margins [6], seasonal hypoxia (DO <2.0 mg/L) adjacent to the Changjiang Estuary at the

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subsurface and bottom water were observed by many previous surveys [7,8]. However, locations, degrees and distribution patterns of those hypoxia zones varied in different surveys under different marine environment.

2 Stations and Measurements

The State Key laboratory of Estuarine and Coastal Research carried out an interdisciplinary field survey on board of R/V *KAN407* off the Changjiang estuary within a region from 29.5°N to 32.5 °N and from 122.5°E to 124.0°E from August 27 to September 2, 2009. A SeaBird 19plus CTD with sensors of chlorophyll-a and dissolved oxygen (DO) was downcast at 55 stations, including 7 east-west sections (Fig.1). Measurement of turbidity was done by a OBS-3A sensor. The observation instruments were dropped slowly from the surface water to the bottom using an electric winch, and then lifted up slowly to the sea surface with the sampling time interval of 0.1 s. The data obtained by the SeaBird 19plus CTD were filtered and averaged at 0.5m intervals.

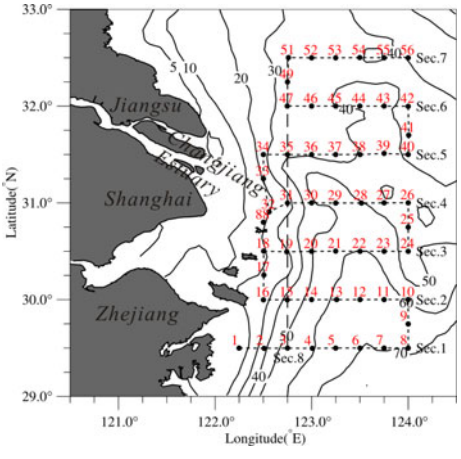

Fig. 1. The measured stations and sections off the Changjiang Estuary. Contours are isobath, unit: m.

3 Results and Discussion

3.1 DO and Chlorophyll-a Distribution Adjacent to Changjiang Estuary

DO concentration varied from 4.79 mg/L (Sta.44) to larger than 10.0 mg/L (Sta.19) at the depth of 1 m. A good linear relationship existed between DO and chlorophyll-a at a depth of 1 m (r^2=0.6662, n=55; Fig.2). Surface DO in the high chlorophyll-a zone was generally higher than 7.0 mg/L, the area of high DO was along 122.75°E, the north-southward Sec.8, the maximum value was greater than 8.0mg/L(Fig.3a). Surface DO in the TWC (Taiwan Warm Current) area was slightly lower, around 6.5mg/L, and the minimum value existed off the Jiangsu Coast (JSC), lower than 6.0mg/L.

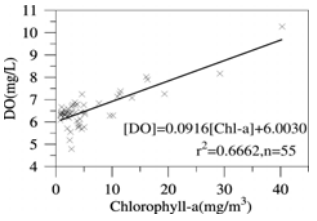

Fig. 2. Regression analysis of Chlorophyll-a against DO at a depth of 1 m beneath the surface

The chlorophyll-a concentration at a depth of 10 m was less than 6.0mg/m^3 in most of the investigated area, except for the western part of Sec.2 (Sta.15&16). Though, the DO concentration was generally greater than 5.5 mg/L along the Sec.2. On the contrary, there were two hypoxia zones at the western part of Sec.1 and Sec.3 to Sec.5 with the DO < 4.0mg/L. In the zone of TWC, DO at the depth of 10m was higher than 6mg/L (Fig.3b). At the depth of 20m(Fig.3c) and 30m(Fig.3d) beneath the surface, the pattern of DO distribution was similar to the DO distribution of the depth of 10m, and there exited hypoxia zones with DO < 2mg/L both of the two layers. The region of hypoxia zones with DO< 2mg/L at the depth of 30m was larger than the hypoxia zones of 20m, and DO of nearly half of the investigated area was lower than 3.0mg/L at the 30m layer.

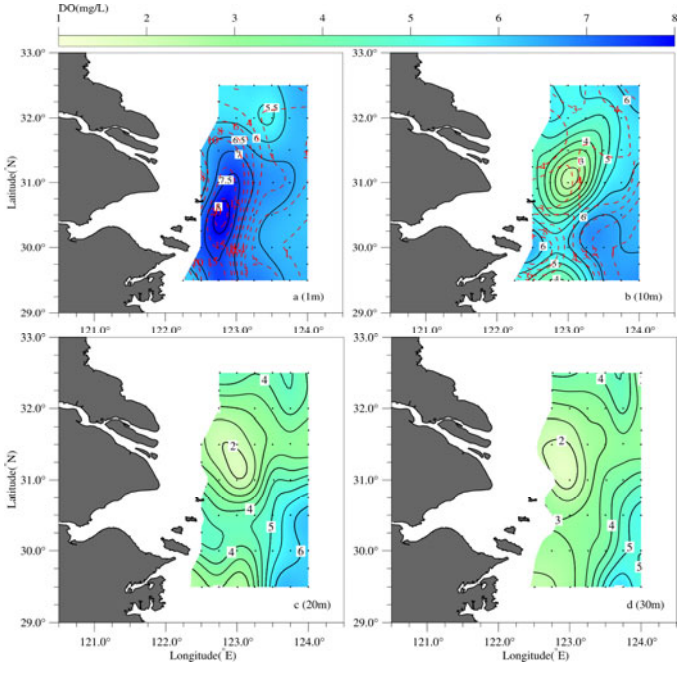

Fig. 3. Distribution of DO (image, real lines with labels white-under, unit mg/L) and Chlorophyll-a (dashed lines with labels no-white-under, unit mg/m3)

The vertical distribution of DO also shows that there existed high DO zones of > 7mg/L at the surface layer (Fig.4) corresponding to the high Chlorophyll-a zones of >10 mg/m^3. The bottom hypoxia zones located as same as the surface high chlorophyll-a

zones. The hypoxia zones (DO < 2.00 mg/L) were commonly discovered at the bottom water along Sec.1, 4 and 5 (Fig.4). Hypoxia was particularly serious at Sec.4, the DO contour of 2.00 mg/L rose to a depth about 10 m, indicating upwelling existed there. The minimum DO recorded in this survey was down to 1.02 mg/L.

3.2 Response to the Water Properties

The surface turbidity front off Changjiang Estuary located at about 122.5°E at a depth of 1 m beneath the surface (Fig.5), with the highest turbidity about 5.0 NTU. Turbidity decreased gradually seaward, and was only 1.0 NTU at 123.0°E. On the east side of the Zhoushan Island, the western part of Sec.2, turbidity was lower and the DO was higher than the northern and southern adjacent area. The situation of turbidity distribution showed a northeastward expansion trend of the CDW (Changjiang Dilute Water). Phytoplankton bloom generally occurs in eutrophic water whenever suitable light and temperature conditions are available. Hypoxia zones were almost within the area of surface turbidity < 1.0 NTU (Fig.5) due to the mass phytoplankton cells and organic material contained by the CDW.

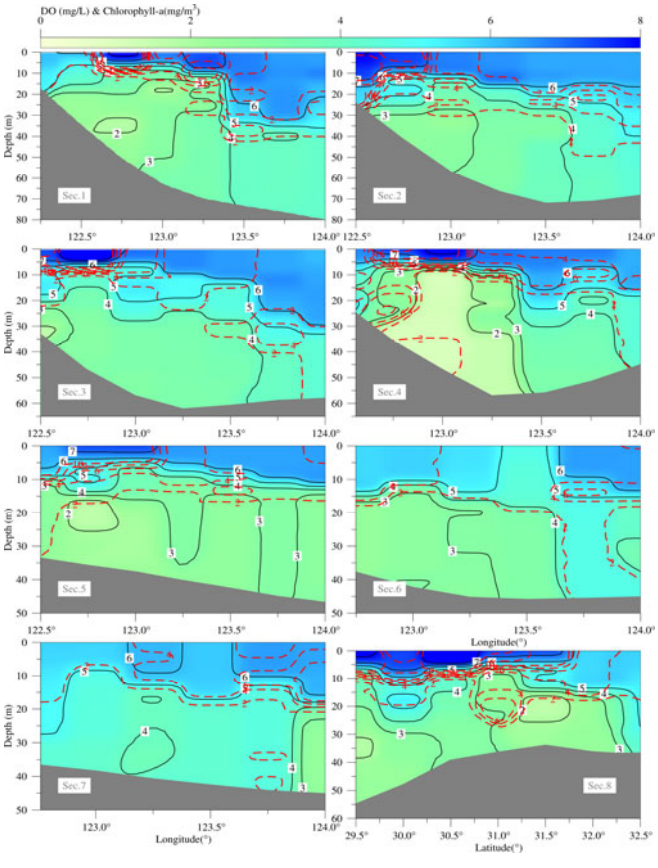

Fig. 4. Vertical distribution of DO (image, real lines with labels white-under, unit mg/L) and Chlorophyll-a (dashed lines with labels no-white-under, unit mg/m3)

The northeastward expansion of the CDW is the most important hydrological features off the Changjiang Estuary in summer [4]. It was recognized that the CDW would expand north-northeastward in the case that the river discharge is lower than the long-term average distinctly [9, 10]. The average river discharge at Datong station was 42600 m^3/s in August 2009, nearly equal to the August monthly mean value of 43000 m^3/s in the past 40 years [11]. The northward tendency of CDW expansion was not obviously in August-September 2009, and the minimum salinity at 32.0°N was more than 30.0 at the depth of 1 m beneath the surface. On the contrary, the lowest surface salinity around 123.0°E was 26, indicating an evident tendency of east-northeast expansion of CDW (Fig.6a). The bottom salinity distribution indicated the penetration of TWC off the Changjiang Estuary and the salinity isohalines of 33 was along the submarine valley approximately (Fig.6b).

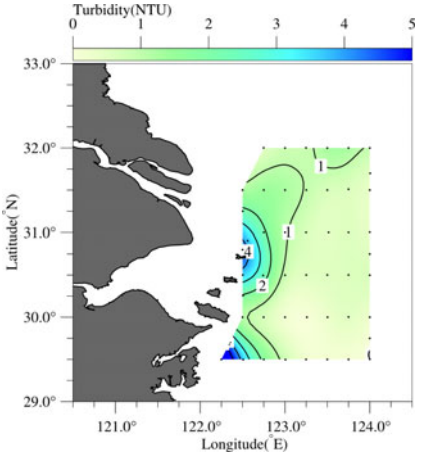

Fig. 5. Distribution of turbidity at a depth of 1 m below the surface (No data at Sec.7 because of technical problem of the OBS)

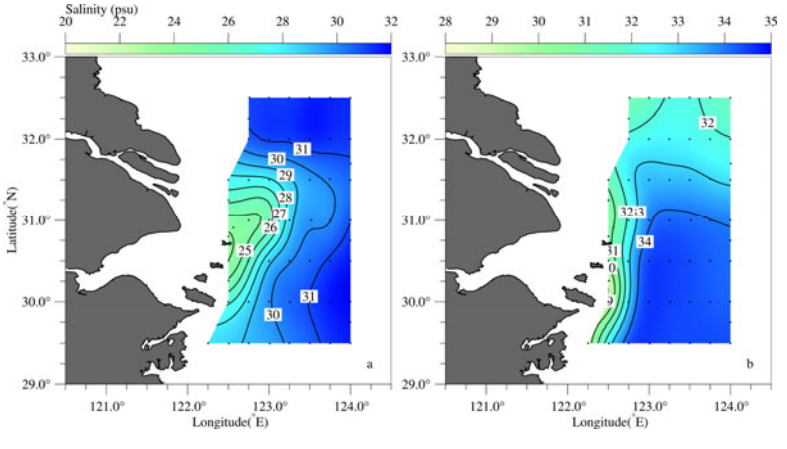

Fig. 6. Distribution of salinity at a depth of 1 m beneath the surface (a) and at the bottom layer (b)

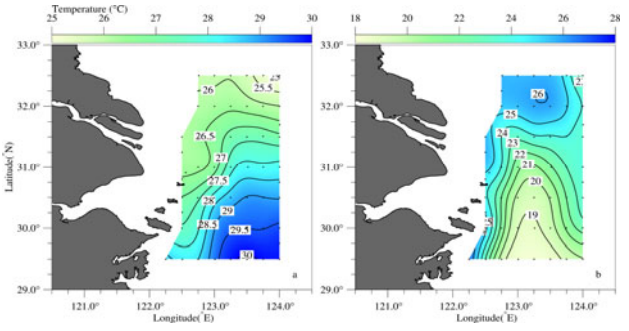

Fig. 7. Distribution of temperature at a depth of 1 m beneath the surface (a) and at the bottom layer (b)

The temperature of surface water on west side of 122.75°E from Section.1(Sec.1) to Sec.5 was lower 1-2°C than the east side area controlled by the TWC (Fig.7a). In zones controlled by TWC, the temperature difference between the surface and bottom was >10.0°C. The bottom temperature was colder than 20°C, and the isothermal distribution of the cold water approximated to the isobaths of the submarine valley (Fig.7b).

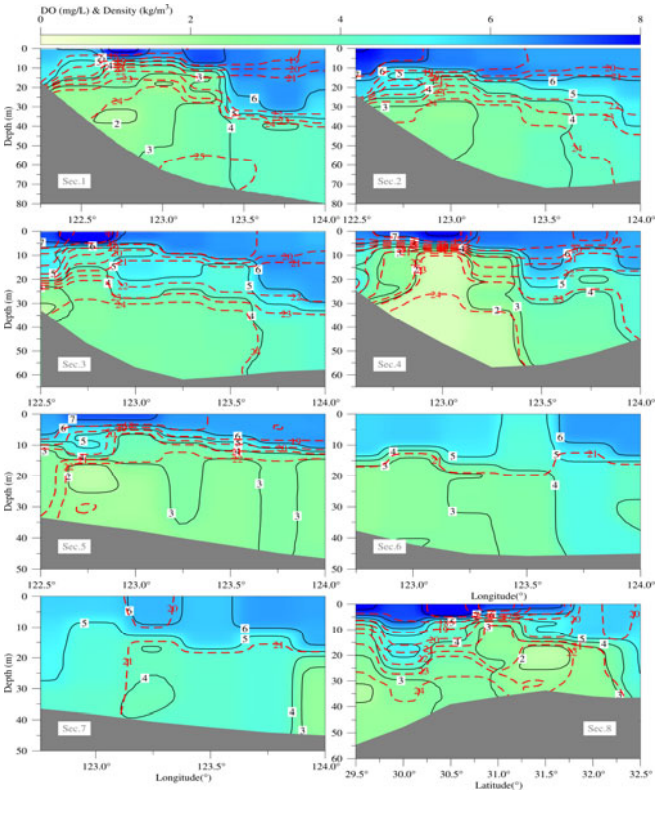

Fig. 8. Vertical distribution of DO (image, real lines with labels white-under, unit mg/L) and density (dashed lines with labels no-white-under, unit kg/m3)

The vertical distribution of salinity and temperature are omitted in this paper and the vertical distribution of density is showed in Figure 8. Varying intensity haloclines existed in the vertical at Sec.1 to Sec.5, and the strongest halocline occurred at Sec.4 which was along 31°N. Due to the weak tendency of northward expansion of CDW, the difference of salinity between the surface and bottom water at Sec.6 and Sec.7 was very small. The axis of the fresh water tongue was along the Sec.4 approximately (Fig.6a), and there were double haloclines in vertical water columns, the first halocline was located at a depth of 5~10 m, and the second halocline was located at the deeper water of 10~25 m. Along Sec.8, the strongest halocline occurred from 30.5°N to 31.5°N in the north-southward.

Strong thermoclines existed from Sec.1 to Sec.4, the difference of temperature between the surface and bottom water at Sec.5 was relative small, and there was no thermocline at Sec.6 and Sec.7. Depth of thermoclines was deeper than the depth of haloclines generally. Due to the existence of strong thermoclines and the double haloclines, water columns at Sec.1-5 had strong stratification, on the contrarily, water at Sec.6 and Sec.7 mixed well (Fig.8). As a result, hypoxia of Sec.4 was the most serious in our survey, and there were no hypoxia zone at Sec.6 and Sec.7.

One of the most important explanations for the hypoxia in bottom water is the deposit of mass phytoplankton from the surface water to bottom water after its death, those deposited phytoplankton would then consume much oxygen during the processes of oxidization [7]. On the other hand, pycnoclines formed due to the buoyancy of CDW (high temperature and lower salinity) and the upwelling (low temperature and high slinity) climb along the submarine valley should obstruct the extension of high chlorophyll-a to deeper water and oxygen exchanges between the surface and bottom water (Fig.8).

3.3 Vertical Stratification and the Maintenance of Hypoxia

Depth ratio of the euphotic layer to the surface mixed layer was 1.2 in spring, and then increased to 5.2 in summer [12], that indicating the strong vertical stratification of water in summer. Water column stratification (or stability) is one of the important control conditions of the vertical distribution of oxygen and the maintenance of hypoxia. In order to quantify the degree of the water column stratification, we applied the potential energy anomaly parameter (PEAP) φ (J/m^3) as the stratification parameter [13]:

$$\varphi = \frac{1}{h}\int_h^0 (\overline{\rho} - \rho) \times g \times z \times dz \tag{1}$$

with the depth mean density:

$$\overline{\rho} = \frac{1}{h}\int_h^0 \rho \times dz \tag{2}$$

Where $\rho(z)$ is the density profile, h is water column depth, z is the vertical coordinate and g is gravitational acceleration. Hence, φ represents the amount of mixing work required per unit volume to transform a stratified water column to a completely vertically mixed water column. φ is positive for a stable stratification, zero for a completely mixed water column and negative for an unstable stratification [14,15].

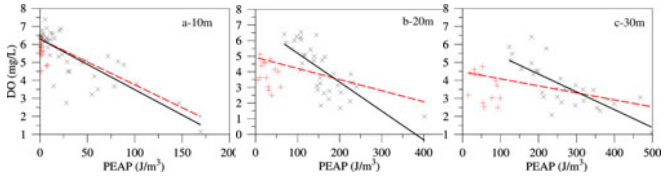

Fig. 9. Regression analysis of PEAP -a against DO at a depth of 10m(a), 20m(b) and 30m(c). The solid lines are the result of total data, and the dashed lines are the result of except data of Sec.6 & Sec.7(symbols of plus).

A good linear relationship existed between PEAP and DO (Fig.9) at the depth of 10m. For well mixed of Sec.6 and Sec.7, the square of correlation coefficients at the depth of 20m and 30m were lower than 0.2. We attempted to eliminate the data of the well mixed Sec.6 and Sec.7 and get nicer result as shown in the Fig.9 (solid lines) and Tab.1. We can draw a conclusion that a good linear relationship between the PEAP and DO would present when or where the PEAP was more than a given value.

Table 1. Regression analysis of PEAP against DO

		n	r^2	Regression formula
10m	total	54	0.5591	DO=－0.0254PEAP＋6.0627
	except Sec.6&Sec.7	40	0.6257	DO=－0.0281PEAP＋6.2949
20m	total	49	0.1628	DO=－0.0071PEAP＋4.9274
	except Sec.6&Sec.7	35	0.5507	DO=－0.0185PEAP＋7.0452
30m	total	43	0.1927	DO=－0.0039PEAP＋4.4752
	except Sec.6&Sec.7	30	0.5849	DO=－0.0099PEAP＋6.3302

3.4 Esitmation of the AOU

Apparent oxygen utilization (AOU) was applied to estimate the degree of the oxygen depletion. AOU was calculated by [7]:

$$AOU = C_{O_2}^{s} - C_{O_2} \tag{3}$$

Where $C_{O_2}^{s}$ was the saturated concentration of DO under atmospheric pressure of 101.325KPa and humidity of 100%, C_{O_2} was the local DO concentration measured by CTD.

Table 2. Parameters of hypoxia zones

	<2.0 mg/L		<2.5 mg/L	<3.0 mg/L
	Our survey	Li et.al		
Area of hypoxia(km^2)	3735	13700	9878	24047
Water volume of hypoxia(km^3)	88	—	217	506
Average water thickness of hypoxia(m)	23.6	20	21.9	21.1
AOU ($\times 10^6$t)	0.49	1.59	1.11	2.35

The investigated area was meshed by a horizontal resolution of 0.05°×0.05°, then the DO and AOU values of each mesh points were interpolated by bilinear interpolation with a vertical resolution of 0.5m. The area, water volume, average water thickness and the AOU of regions with DO lower than 2.0mg/L, 2.5mg/L and 3.0mg/L were estimated respectively (Tab.2). The hypoxia during our survey was relatively less serious than that of Li's survey [7] carried out in the later summer of 1999 (Aug. 20-30). For the existing of the extensive potential hypoxia zone of DO <3.0 mg/L during our survey, the situation of oxygen depletion off the Changjiang Estuary was not optimistic in recent decades.

Surface AOU was controlled by the surface concentration of Chlorophyll-a though the surface AOU had negative values at the zone of high Chlorophyll-a (Fig.10a). Same as DO and PEAP (Tab.1), the distribution of AOU and PEAP existed a good relationship at the depth of 10m, 20m and 30m (Fig.10b, c, d) respectively. That means the stratification degree of water upper than the depth of 10m, 20m and 30m had a good linear relationship with the hypoxia degree of those layers. The maximum AOU at the hypoxia zone was more than 5.0mg/L beneath the depth of 10m.

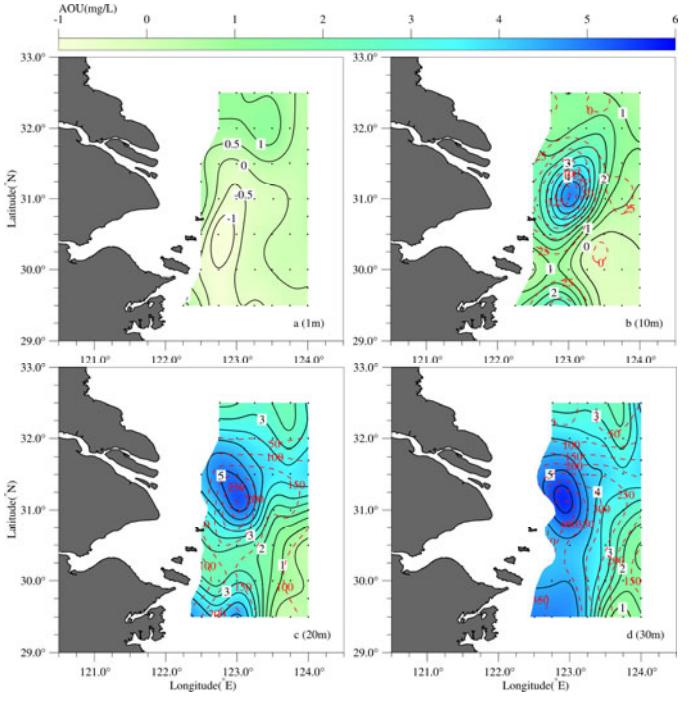

Fig. 10. Distribution of AOU (image, real lines with labels white-under, unit mg/L) and PEAP (dashed lines with labels no-white-under, unit J/m3)

4 Conclusion

Based on the interdisciplinary comprehensive survey conducted on board of R/V KAN407 off the Changjiang Estuary from 27 August to 2 September 2009, the distribution pattern of DO in later summer was obtained (Fig.3,4). The characteristics of DO distribution was affected by the Chlorophyll-a in the surface water, and was affected mainly by stratification in the water 10m beneath the surface. Strong relationship between stratification variable (PEAP) and hypoxia is demonstrated. The area, water volume, average water thickness and the AOU of the hypoxia zones were calculated by bilinear interpolation at each meshed points. The situation of oxygen depletion off the Changjiang Estuary was not optimistic in recent decades.

Oxygen depletion is affecting large marine ecosystems allover the world. The mechanisms causing hypoxia differ slightly from region to region, causing permanent, periodic or seasonal hypoxia, often accompanied by an excessive input of organic material [16]. Seasonal hypoxia off the Changjiang Estuary has been connected with the transport of nutrients by CDW and an increase in primary production, leading to increased oxygen consumption in middle and near-bottom water under strong stratification. Hypoxia off the Changjiang Estuary is relevant to various biological, chemical and physical processes. Comprehensive and long term field observations combined with ocean ecosystem dynamics models shall be applied for further studies of hypoxia off the Changjiang Estuary in the future.

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Research of DSS Based on Logistics Cost Subject Data Warehouse

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Abstract. This paper proposes a data warehouse model based on the logistics cost subject domain with the star schema. The center of schema was the logistics cost fact table surrounded by multidimensional tables. The logistics cost describing data from different dimensions was clustered, and then mined using associational rules. DSS based on the logistics cost subject data warehouse has provided important decision-making support to the cost reduction of logistics enterprises.

Keywords: Data warehouse, clustering, association rules, DSS.

1 Introduction

At present, the logistics business and logistics enterprises has reached a rapid growth. Naturally, the competition between enterprises is unavoidable. If these enterprises want to remain competitive advantage, they must consider some factors; the most important factor is the control of cost. How to try their best to use and mine the existing data to support scientific decision-making, reduce cost, and get benefit maximization, has been recognized by many large logistics enterprises. The logistics industry is one of the emerging industries combining transportation with information management. The logistics data is massive but very lack, because it is large, redundant, scatter, heterogeneous. So the logistics service system is only a tool for data entry, the logistics database is a place to store data, but data becomes "death data" because the data will not change the storing way. It is meaningless for enterprises to make decision based on these data.

Data warehouse, or DW, is used to process data, such as query, analysis, extraction, conversion, optimization, integration etc. It is worth mentioning that these processes were conversed into redundant, massive, scattered and heterogeneous data. Therefore, data warehouse is very useful for enterprises to make decision. Decision support System, or DSS, refers to semi-structured or unstructured decision-making computer applications system, which will assist decision-makers with decision-making through the excavated data, model and knowledge from DW[1].

2 Composition of Logistics Cost

According to the cost items, logistics cost can be divided into two kinds: the logistics function cost and the cost associated with inventory. The logistics function cost

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includes the spending of logistics activities, such as, packaging cost, transportation cost, storage cost, loading and unloading cost, circulation processing cost, logistics information cost, logistics management cost .etc. and the inventory-related cost includes these spending of inventory activities, such as, capital occupation cost, goods consumption cost, insurance and tax cost, and so on. The following is a simple description of some cost:

(1) Transportation cost: it refers to all charges that are spent by the corporate for goods transportation business during the certain period, including personnel cost that engages in of goods transport operation, fuel fees of vehicles (including other means of transport), depreciation charges, maintenance fees, lease fees, road maintenance, tolls, annual fees, accident damages, other related taxes, etc.

(2) Logistics information cost: it refers to these cost that is used to collect, transmit, process logistics information in certain time, and related with order processing, storage management, customer service. Specifically speaking, this cost includes logistics information personnel expenses, software and hardware maintenance fees, depreciation, communication, etc.

(3) Insurance and tax cost: it includes insurance premium and tax expenditure paid by enterprise in a period of time. The former is manly related with inventory property, and the latter is used to purchase and sale of goods.

3 Characteristics of Logistics Cost Data Warehouse

The characteristics of data warehouse can be understood from the definition. The acknowledged data warehouse definition defined by W.Hinmon is described as following: "data warehouse is a collection of data, which is to support management decision-making process, subject-oriented, integrated, changed and sustained." From the definition, W.Hinmon pointed out the most four important features including subject-oriented, integrated, stabled, and changing with time. Of course, the characteristics of logistics cost data warehouse also include these four aspects.

(1) Subject-oriented. Generally speaking, data structure can be constructed based on the way of optimizing transaction processing in business system, so data on same subject is often distributed in different business database. For example, the logistics transportation cost is described not only in the transport vehicle scheduling (fuel, rental fees, road maintenance, tolls, accident damage, etc), but also in vehicle management system (depreciation charges, maintenance fees, annual inspection fees, related taxes, etc.). Because data sets distributed in different database would be accessed when we analyze the logistics cost subject data, it is extremely unfavorable to use these scattering data to analyze and make decision support. The features-subject oriented of data warehouse had been set to solve this problem.

(2) Integrated. The data stored in data warehouse refers to some data items processed complicatedly, which had been extracted not copied simply form the various original subsystems distributed in different domains. Take one example, the data for

the same subject are stored in different databases; take another example, different database systems are used in the different business systems. For different logistics centers, Even if the business system has the same function, but may use a different type of database, and even if the types of database are same, but the names of fields used to describe same physical meaning may be different (this situation would be aroused when different between enterprises combined, reorganized, merged, purchased, etc.).

(3) Stabled. Business systems usually require only current data, and stored generally short-term data. Therefore, data in the database system is unstable, which record every transient changing in the system. This feature was more serious in the logistics enterprise. Only businesses signed but not received by customers are concerned in operational system. Once these businesses can be completed, the data about businesses would become useless.

But for decision analysis, historical data is very important, and many analysis methods would not work without these historical data. It is very difficult to predict the development trend of the enterprise if detailed analysis of historical data wasn't completed. Therefore, data Extracted from different data sources should be stored in the data warehouse, and users can query, analyze them by system analysis tool, but can not modify these data.

(4) Changing with time. Data of data warehouse will be updated regularly with time. Therefore, these data are given a higher demand on the breadth of space and time.

4 Construction of DSS Based on Logistics Cost Data Warehouse

4.1 DSS Structure of Logistics Cost Data Warehouse

The DSS structure based on logistics cost data warehouse is shown in Figure 1. The structure can be divided into three parts:

- Source data: the source data refers to external heterogeneous data from different regions, different types of databases, and data items that have different names.
- Data warehouse management: ETL (Extract-Transform-Load) refers to the process of data extraction, transformation, cleansing, loading, and is an important link to build a data warehouse. Users extract the required data from the data source, and then clean data, finally load data into data warehouse in accordance with the predefined data warehouse model.
- Decision-making for analysis process: OLAP (On-Line Analysis Processing) is a kind of software technology to rapidly access and analyze online data sharing multi-dimensional information or solving special problems. Data can be accessed fast, stably and consistently, interactively through the observation to possible information forms, and the decision-makers can insight into data. Data used to decision-making is multi-dimensional, so multi-dimensional data is the main content of decision-making. The information summary is indicated by a graphic or tabular form.

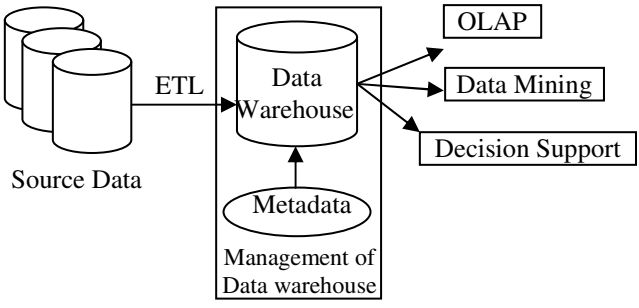

Fig. 1. DSS structure based on logistics cost data warehouse

4.2 DSS ConstructionProcess

Because the characteristics including decision support-oriented, a large amount of data, data updating frequently, data warehouse must be designed to meet requirements that query performance does not decrease when the amount of data rapidly increases and to provide powerful decision support for decision-makers.

1) Determine subject domain and design physical storage structure of data warehous

The first step of building data warehouse is to determine the subject field because the data warehouse itself is subject domain-oriented. In this project, the subject domain was set according to logistics cost.

The next step is to develop the physical storage structure of data warehouse after determining the subject domain. The fact tables and dimension tables must be built because the relational database is not multi-dimensional and can't be adopt in this system.

Fact table usually contains a large number of lines. The main feature of fact tables includes digital data (facts), and the digital information can be aggregated. Fact table consists of two parts: one part is used to describe the primary key of dimension table, and the other part refers to the numerical measurement related topics, or facts. Some of major fields and their description about logistics cost fact table are shown in table 1.

Table 1. Some major fields and their description

Field Names	**Description**
Date_key	The primary key of date table
Zone_key	The primary key of region table
Vehicle_key	The primary key of vehicle table
Cargo_key	The primary key of cargo table
……	……
Transport_cost	Transportation costs
Storage_cost	Storage costs
Packing_cost	Packing costs
Manage_cost	Logistics management costs
Wastage_cost	Wastage costs
……	……

Dimension table can be seen as window that the user analyzes data. Dimension table contains the characteristics of the fact records from fact table and hierarchical structure to help summarize data features. Some characteristics provide descriptive information, and other characteristics specify how to aggregate fact data from fact table, which would provide useful information for analyst. The major fields of the logistics cost tables are shown in table 2:

Table 2. Some major fields of logistics cost tables

Date Dimension	Cargo Dimension	Transport Dimension
Date_key	Cargo_key	Transport_key
Year	Class	fuel_fee
Quarter	Name	Tenancy_fee
Month	Weight	Maintain_fee
Week	Volume	Tax_fee
Day	……	……

Star model is used to model data warehouse in this project. The center of model was the fact table of logistics cost surrounded by some multimensionla tables, as shown in figure 2. Different analysis dimensions refer to observing the fact from different angles and aggregate fact particle according to different dimensions.

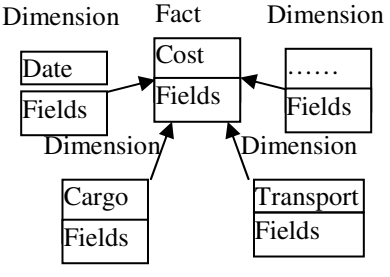

Fig. 2. Star Analysis Model Based on Logistics Cost Data Warehouse

2) ETL

a) Data extraction: The subject of this project refers to logistics cost, so extracting data related cost from different regions, different type of databases, different forms, and different fields to form original data in the first phase of building data warehouse.

b) Data transformation: the conversion process can be epitomized as following:

- Processing null value. Processing null value includes capturing null field value, loading or replacing null value with other data, loading null value to different object library. For example, not every business has a breach cost, so the value of breach cost can replace with 0.
- Standardizing data format. ETL allows constraint definition of field like setting self-defined format for time, numerical, character and other data of the data source. For example, the type of field "violation record" is set Boolean in vehicle scheduling

system. Of course, different branch may give different types to define similar field. As shown in Table 3, the type of this field would be named as Boolean after conducting standardized data format.

Table 3. Example of standardized data definitions

Type	Value Domain
Boolean	True, False
Number	1, 0
Character	Y, N
String	"True" "False"
……	……

- Splitting data. The field would be decomposed according to business need. For example, the data of date can be split into year, month, and day.
- Data replacement. Some invalid data, missing data must be replaced to meet needs of operational factors.
- Establishing constraint on foreign primary key. The illegal data without dependence must be replaced, or exported to the wrong data file to ensure that the primary key of loading record is unique.

c) Loading data: The required data that user extracted from source data would be loaded into pre-defined data warehouse after data transforming and cleaning.

3) Data mining

We use the association rules to mine information from logistics cost database. Firstly, we identified a large item sets, mileage vehicles, communications charges and default charges, from the original data set. There is no direct relationship between literal forms, however, from the data view, if vehicle mileage is high, the communication cost and default cost would be correspondingly high. We set two threshold values, the minimum support and the minimum confidence by clustering communication costs and default fees on vehicle mileage greater than or equal thousand kilometers in dimension mileage. This is described as following:

Minimum Support: min_support = 5%
Minimum Confidence: min_confidence = 70%

Data obtained after analysis is very satisfactory. Support (mileage vehicles, communications charges, default charges) = 7.26%, and confidence (mileage vehicles, communications charges, breach of contract fee) = 86.33%. Physical meaning of these data including that every driver's communication costs are capped in most logistics enterprises, and breach of contract fee would be produced except the driver can't supply ordered goods to customs. When vehicle mileage is greater than 100,000 km, the vehicle broke down easily on the road. At this point, the driver would communicate with family members, so communications charges would increase, the time sending goods would exceed, and default rates would increase. Therefore, the conclusion is the mileage of vehicles exceeding 100,000 km should be scheduled if transportation task need strong time, because his decision greatly reduced the cost of default.

5 OLAP and Experimental Results

In this project, relational OLAP and the star model for describing data structure were used and shown in figure 2. OLAP allows management decision-makers insight into the data through accessing data fast, stably and consistently after observation to a variety of data forms.

This project allows users observe final analysis results form DSS by selecting different dimension and particle size. The cost results from geographical dimension and transport dimension can be shown from figures 3 to figure 6, at the same time, the results were further stratified cost from the particle size dimension and stratified particle size dimension.

Note that the cost described in this paper refers to cost per kilometer per kilogram, and its unit is not the RMB yuan. In each dimension, the maximum value of the transportation costs, logistics information costs and insurance and tax costs were set to 10, but the value of other data can be gotten by comparing to this value. Figure 3 shows that the unit transportation costs were set to 10 in Hong Kong, Macao and Taiwan regions.

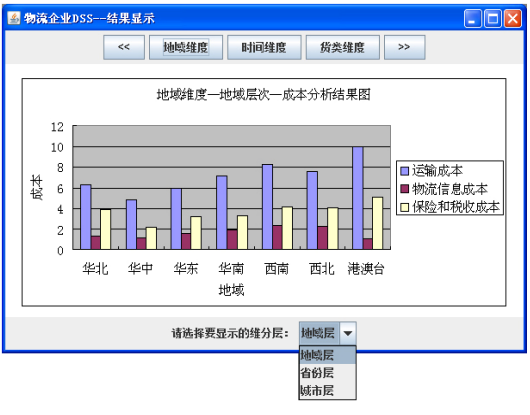

Fig. 3. The Analysis Results of Cost According to Region Dimension -Regional Stratified Particle Size

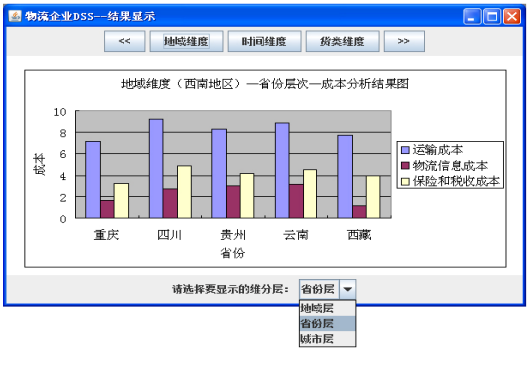

Fig. 4. The Analysis Results of Cost According to Region Dimension (Southwest Region) - Provinces Stratified Particle Size

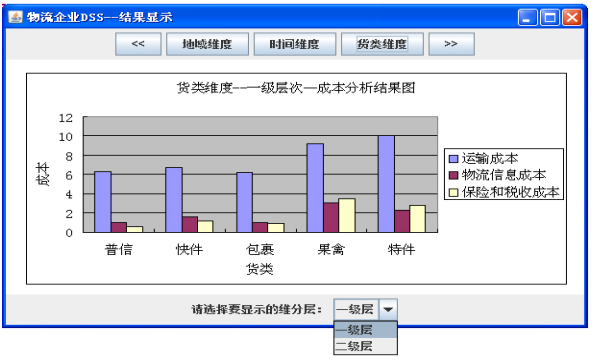

Fig. 5. The Analysis Results of Cost According to Cargo Dimension –First Grade Particle Size

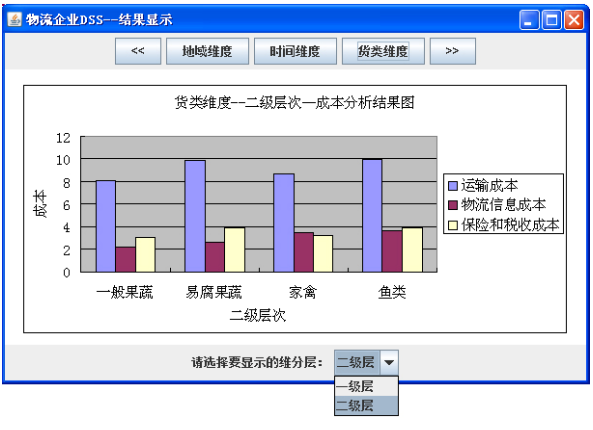

Fig. 6. The Analysis Results of Cost According to Cargo Dimension –Second Grade Particle Size

6 Conclusion

The competition that modern enterprises are confronted is becoming cruelly, and the conditions affecting decision-making is getting more complex. DSS development based on logistics cost subject data warehouse plays a very important role in decision suppuration from different angles to reduce cost for logistics enterprises. So that logistics enterprises are not only high-speed data creators, but also excellent users of large amounts of data. DSS based on logistics cost subject data warehouse supports faster and better development for logistics enterprises.

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Automatic Extraction of Terminology under CRF Model

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Abstract. An automatic terminology extraction method in specific domain is proposed based on condition random fields (CRF) in this paper. We treat extraction of terminology in one domain as a sequence labeling problem, and terminology distribution characteristics as features of the CRF model. Then we use the CRF model to train a template for the terminology extraction. Experimental results show that the method is effective and efficient with common domains.

Keywords: CRF, Named Entity, Terminology Extraction.

1 Introduction

Terminology is the effective and basic vocabulary to describe domain knowledge unit. And terminologies play an significance role in automatic extraction of terminologies in natural language processing research. It is one of the important methods in the domain ontology construction too. Also it is widely used in information retrieval, information extraction, data mining, machine translation and other information processing. Two indicators have to be calculated in automatic terminology extraction algorithm, one is the area, and the other is the unit indicators. Two new concepts were proposed by Kage: Unithood and Termhood. Unithood is a measure indicator with the structure as a language characters array in sense of the strength and stability; Termhood is the measure indicator of a linguistic unit as a the concept of special areas. For decades, researchers have explored various techniques for identifying interesting collocations. There have essentially been three separate kinds of approaches for accomplishing this task. These approaches could be broadly classified into (1)segmentation-based,(2)word-basedand knowledge driven,or (3) word-based and probabilistic[1]. The paper provided two major evaluations of nine existing collocation-finders and illustrate the continuing need for improvement with Latent Semantic Analysis to make modest gains in performance. The ratio, TF/IDF, of frequency and document frequency is the most commonly methods about Termhood measure.

This ratio indicates the joint influence of frequency of one word in a document and document set. In this paper, part of characters can be filter out for meaningless words. Random field model, CRF, is adopted to unite these features together, and the experiment achieved good results.

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2 CRF Model

2.1 CRF

Conditional random fields (CRFs) structure was introduced originally by Lafferty et al in 2001[2]. Conditional random fields (CRFs) are a probabilistic framework for labeling and segmenting structured data, such as sequences, trees and lattices. The underlying idea is that of defining a conditional probability distribution over label sequences given a particular observation sequence, rather than a joint distribution over both label and observation sequences. The primary advantage of CRFs over hidden Markov models is their conditional nature, resulting in the relaxation of the independence assumptions required by HMMs in order to ensure tractable inference. Additionally, CRFs avoid the label bias problem, a weakness exhibited by maximum entropy Markov models (MEMMs) and other conditional Markov models based on directed graphical models. CRFs outperform both MEMMs and HMMs on a number of real-world tasks in many fields, including bioinformatics, computational linguistics and speech recognition. Lafferty et al define the probability of a particular label sequence y given observation sequence x to be a normalized product of potential functions, each of the form:

Definition 1:

$$\exp\left(\sum_{j} \lambda_j t_j(y_{i-1}, y_i, \boldsymbol{x}, i) + \sum_{k} \mu_k s_k(y_i, \boldsymbol{x}, i)\right) \tag{1}$$

where tj(yi−1, yi, x, i) is a transition feature function of the entire observation sequence and the labels at positions i and i−1 in the label sequence; sk(yi, x, i) is a state feature function of the label at position i and the observation sequence; and λi and μk are parameters to be estimated from training data.

When defining feature functions, we construct a set of real-valued features b(x, i) of the observation to expresses some characteristic of the empirical distribution of the training data that should also hold of the model distribution. And as general, we can define:

$$s(yi,\ x,\ i) = s(yi\text{-}1,\ yi,\ x,\ i) \tag{2}$$

3 Automatic Extraction of Terminology

Terminology extracting in a specific domain is similar with named entity recognition to some degree, but terminology implies more knowledge of some areas, while the CRF model can easily contain domain knowledge with set of features functions. Selecting appropriate task-specific features set is a very important job to CRF model, which is simple feature representation of complex linguistic phenomena. Fig.1 depicts the framework of terminology extraction in one domain in CRF model.

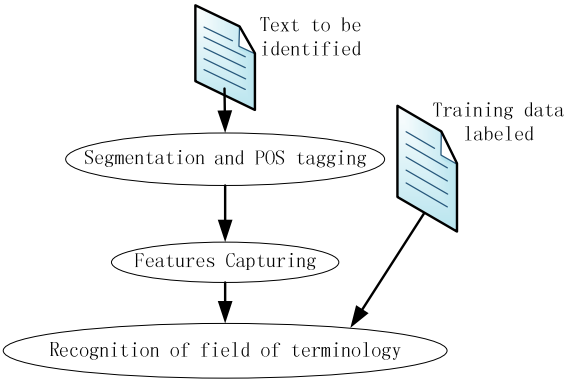

Fig. 1. CRF based terminology

The words itself may also provide a lot of domain knowledge among features selected. Part of speech features is an important feature of the terminology. In general, terminology is nouns, compound nouns or parts of the verb. Information entropy is the factors to determine whether a word is an important indicator of boundary terms. It is based on the uncertainty of the word W with the adjacent words to judge whether the word W can be used as a boundary terminology. If there is no more fixed to the left of the word w, we can take w as the term of the left border. This article uses following formula (1) to estimate the entropy of a vocabulary:

$$E_l(w) = -\sum_{a \in A} p(w_{la} / w) \log(p(w_{la} / w)) \tag{3}$$

$E_l(w)$: left entropy of the word w;
A: the set appearing to the left of the word W.
W_{la}: character string of W with its left side word.

$P(w_{la}/w)$: With appearance of W there, the probability of w left to a. Similarly, the right of information entropy can be calculated. n CRF, Token separator composed of non-maximum continuous combination, generally refers to conditions to deal with the airport's basic unit, its definition varies according to the task.

In CRF, token is the largest continuous characters with none separator. Generally it refers to the basic unit to deal with in the CRF. Its definition varies according to the different task. The mutual information between words are the features. Let w1、w2 be two words, then mutual information of the two words is:

$$M(w_1, w_2) = \frac{p(w_1, w_2)}{p(w_1)p(w_2)} \tag{4}$$

$p(w_1, w_2)$: coexist probability of two words w1, w2;

4 Evauation of Norms and Experiments

4.1 Evauation of Norms

In general, the results of the field of evaluation terminology extraction have the following four indicators: the accuracy ratio of terminology extraction, the recall ratio of terminology extraction, the ration of areas coverage of terminology extraction, and measure value. The formulas of them are as follow:

The accuracy of terminology extraction:

$$r_1 = \frac{\text{Num of correct terminology}}{\text{Num of all terminology be extracted}} \tag{5}$$

The recall ratio of terminology extraction:

$$r_2 = \frac{\text{Num of correct terminology}}{\text{Num of all terminology}} \tag{6}$$

The ration of areas coverage of terminology extraction:

$$F = \frac{2 \times r_1 \times r_2}{r_1 + r_2} \tag{7}$$

4.2 Rule-Bound, Layer CRF under Onology

There are two different methods to set up multi-layer approaches currently. One is Layered CRF, linear combination with each layer; the other is recursive CRF, that is lower layer embed into up layer. Compared with the layered CRF, linear CRF has more sophisticated data structure. So its training and decoding is more sophisticated the layer CRF too. And the loosely coupled relations among layer, every layer can be constructed independently. The complexity of whole model increases with the length of sentence with linear relationship. But in layer CRF, the errors created in lower layer can be adjusted and passed to the up layer. And this can avoid the transmission and spread of errors. According to above analysis, layer CRF is a suitable in named-entity recognization.

In named entity recognization, if there have a dictionary in which words are connected each other with some relationship, it may be helpful. That is ontology. And this is straightforwardly and has been verified by the experiments. In this paper, a layer CRF model under ontology is proposed. In this model, named entity such as time, nation, and equipment identifies with low layer CRF. The outcome of the preliminary will be sent to the high layer model, and then the high layer model identifies the named entity again. Then the input of high layer model is not only observed value but also outcome of low layer model. The identification of all layer go under the ontology supporting. The whole procedure is shown as follow Fig.2.

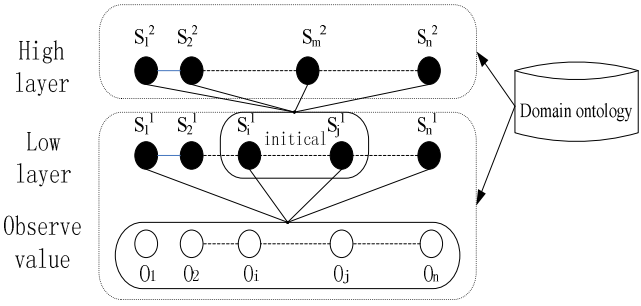

Fig. 2. Named entity identity

And the algorithm is described as fowling:
Input: domain ontology, text to be indentified;
Outcome: named entity such as time, nation, title et al.
Step 1: reading the text to be identified;
Step 2: analysis the text with the help of domain ontology.
Step 3: identification with layer CRF with the word unit.
Step 4: Judging with the help of ontology.
Step 5: With the language rules tag and label the text.
Step 6: Outcome the result.

5 Experiment and Result Analysis

5.1 Template Feature for Time

With the features function given, feature template is instantiated.

$$f_i(x, y) = \begin{cases} 1 & if \ \text{TimUnit}(w_0)=true \ and \ y=time \\ 0 & else \end{cases} \tag{8}$$

Table 1. Template for time entity

Index	Atom template	Implication
1	DataNumber	Is Numerals
2	DataUnit	Is Date Unit
3	DataLeftNum	Is Numerals Pre-word
4	DataLeftUnit	Is Unit Pre-word
5	DataRightNum	Is Numerals Post -word
6	DataRightUnit	Is Date Unit Post-word

5.2 Template Feature for Nation

When we select features for named entity of nations, it is natural to use name of countries, left adjacent words list, right adjacent words list et al, just as Tab.2 show.

Table 2. Atom template for entity of Nation

Index	Atom template	Implication
1	NatName	If the word appear in the common country names
2	NatPOS	Part of Speech of the Word
3	NatFstRBound	If the word near the right side is a country name
4	NatSecRightBoundary	If The second of the right side is a country name
5	NatFstLBound	If the first word of the left side is a country name
6	NatSedLBound	If the second word of the left side is a country name

Index	Composition template
1	NationName & NationPOS
2	NationPOS & NatFirRightBoundary
3	NationPOS & NatFirLeftBoundary
4	NationName & NatFirLeftBoundary
5	NationName & NatFirRightBoundary
6	NatFirRightBoundary & NatSecRightBoundary
7	NatFirLeftBoundary & NatSecLeftBoundary

Fig. 3. Features template for composition of country name

Just as above, with the features function given, feature template is instantiated.

$$f_i(x, y) = \begin{cases} 1 \ \ if \ \ \text{Nation Name}(w_0)=true \ and \ \ y=nation \\ 0 \ \ else \end{cases} \tag{9}$$

6 High Layer CRF Model and Ontology

Word segmentation and POS tagging are the first two steps. Then input the outcome of low layer CRF model to the high layer CRF, and next is feature selecting, just as doing as above in low layer CRF.

And the ontology in one domain should be consider ed carefully. That is to construct the ontology lib for one domain. We have do a excrement on one domain and gain the result as Tab.3.

Table 3. Entity Identity with Help of Ontology

Tagging	Pre(%)	Rec(%)	Fβ=1 （%）
B-FOR	84.9	85.2	84.1
I-FOR	89.3	86.4	87.8

7 Conclusion

With the layer CRF under ontology, the result of named entity identity can gain excellent result. If there have a ontology library, with enough training data, the named entity identity can have a very good solution.

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Research on Service Level Agreement in Cloud Computing

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Abstract. Cloud computing provide cheap and pay-as-you-go computing resources so that more and more consumer begin to use cloud service.Service level agreement(SLA) is a important agreement between both the parties in cloud computing service. It can guarantee the quality of cloud service and quantize the financial relationship between both the parties. A model of cloud service level agreement is proposed which is based on web service level agreement framework. It includes coordination model and management model. It can automatic develop, deploy, measure, assess, manage and end the cloud service.

Keywords: Cloud Computing, Services Level Agreement, Coordination Model.

1 Introduction

Cloud Computing is the development of Distributed Computing, Parallel Computing and Grid Computing or the commercial realization of these computer science concepts. It distribute computing tasks in a resources pool which constituted by many computers, making different application system acquire computing power, storage space and various software services according to the need. Cloud computing can be described as a new form of IT environment which provides dynamic, flexible and scalable virtualization of resources.

With numerous lT giant and start-ups to join, cloud computing market scale present explosive growth. Cloud services are being gradually penetrate into the application of daily information services. The first to launch cloud computing service is amazon.com. As early as in 2006, it launched elastic computation cloud EC2 services and cloud storage S3 which was based on EC2.In 2007, SUN launched mobile data center. April 2008, Google opened Google App Engin and in October, Microsoft introduced Windows Azure operating system, letting Windows extend to clouds from PC.

Along with the development of computing clouds service, an important element that provides some degree of assurance to both users and providers of these cloud resources is the Service Level Agreements. A Service level agreement is a legal format document that includes a description of the agreed service, service level parameters, guarantees, and actions and remedies for all cases of violations [1]. For example, Windows Azure

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SLA entered into force in January 2010.Windows Azure has separate SLA's for compute and storage. For compute, they guarantee that when you deploy two or more role instances in different fault and upgrade domains your Internet facing roles will have external connectivity at least 99.95% of the time. Additionally, they will monitor all of your individual role instances and guarantee that 99.9% of the time they will detect when a role instance's process is not running and initiate corrective action. For storage, they guarantee that at least 99.9% of the time they will successfully process correctly formatted requests that they receive to add, update, read and delete data. They also guarantee that your storage accounts will have connectivity to our Internet gateway[2].

With the competition of cloud computing services increasing, each service providers invested a lot of resources incording to fight for clients, introducing a various preferential measures. But the service quality is always the focus of users. SLAs is the basis of convincing quality. SLAs can intuitively reflect users' expectations of the quality of service. It helps to obtain a higher profits by distinctive pricing to the service according to different SLAs level because of the higher the user's demands towards the Qos , the less the price elasticity of demand become.SLA is an indispensable agreement for both information service parties which can support normal operations of service steadily. It can be said that cloud service will increasingly use SLAs to ensure the quality of the service.

2 Related Work and Background

In recent years, SLA internationally got the popularization. Service providers introduced corresponding SLA from telecom bound to network and attract customers and improved their own competitiveness by promising the QoS of network.

There are two main specications for describing a SLA for web services.1) Web Service Agreement (WS-Agreement) from Open Grid forum (OGF) and 2)Web Service Level Agreement language and framework (WSLA) from IBM. To the best of our knowledge, other most prominent ongoing research project for SLA specication is SLAng. In other related work, Rule-based Service Level Agreement(RBSLA) is highlighted. RBSLA follows a knowledge based approach and uses RuleML to specify the SLA[3].

Here wo choose WSLA as an example to introduce network SLA content. WSLA consists of a set of concepts and a XML language.. It includes three aspects of content: 1) service parties 2) SLA parameters 3) service level goal(SLO). The parties describe the information about service provider, user and third agents. Here the third agents were entrusted to measure service entity, avoided the user and service provider of direct talks and ensured the information symmetry and safety. SLO is used to specify the obligations and all actions when service consumers or service providers do not comply with the guarantees of services. SLA parameters are composed of three types of metrics. 1)resource metrics, in this section, service provider's resources was described as row information. 2) composite metrics calculated combine several resource metrics according to a specific algorithm.3)business metrics relate SLA parameters to financial terms specific to a service customer.

3 Cloud Service Level Agreement Implementation Model

We put forward the SLA model CSLA（Cloud Service Level Agreement）on the basis of WSLA framework. This framework include two model. One is coordination model and the other is management model.

SLA negotiation for a service composition involves two aspects. One aspect is the coordination of negotiation for multiple services to ensure end-to-end QoS. The other aspect is the negotiation between the service consumer and one or many service providers.

We divide cloud computing structure into three layers: infrastructure as service（IaaS）, platform as a service (PaaS）and software as a service（SaaS）. Clients may use more than one type of service.Every service has it own QoS requirement,so we define a Coordinator Agent(CA) which is responsible for the negotiation for the service composition as a whole. If client uses all the types of cloud service, there'll be there SLAs:SaaS SLA(SSLA),PaaS SLA(PSLA),IaaS SLA(ISLA).CA will aggregate them into one. Then the client's SLA will be send to SLA template library.

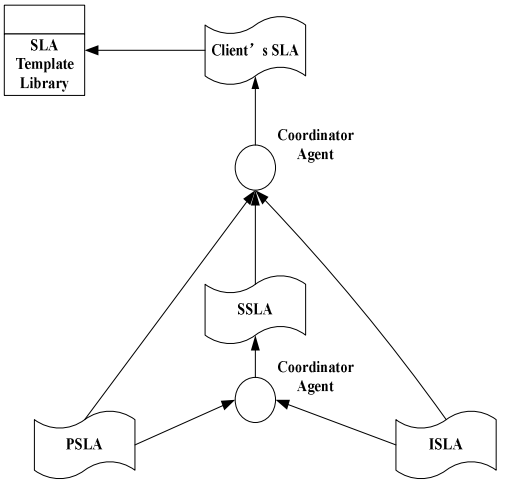

Fig. 1. CSLA coordination model

In our management model, we only implement SLA management for one cloud service. First the cloud is inherently dynamic and the resource usage changes dynamically which users don't know its definite location. So we add dynamic monitoring to ordinary SLA model. It was used in the measuring service to monitor SLA parameters. Secondly cloud computing means that the data will be transferred to computers that the users can't master, so the safety problems must also be considered in SLA model. Here we still establish a trusted third-party entity to ensure service safety and add a trusted negotiation mechanism. Finally the dynamic characteristic of cloud makes us assessments service more frequently. We will dynamic scheduling evaluation in SLA assessment services using specific parameters according to specified conditions.

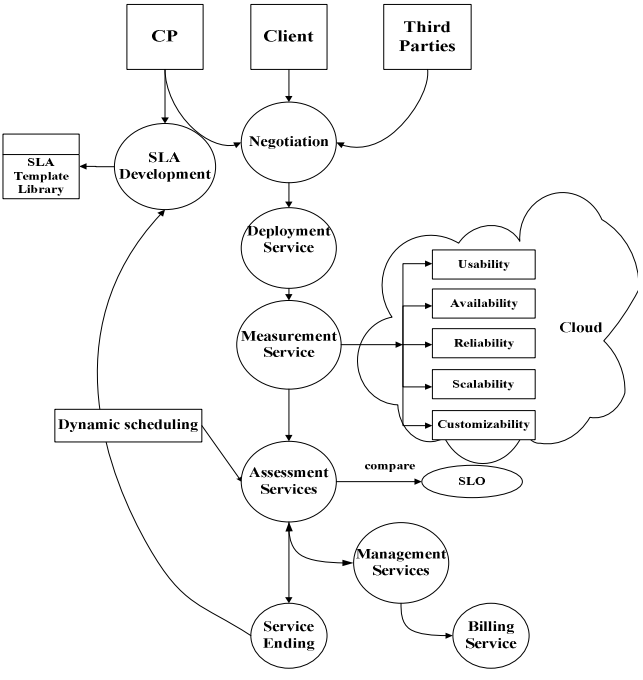

Fig. 2. CSLA management model

Cloud service provider (CP) create their own SLA templates and send part of the instantiation of them to customers.Also they can be delivered to resource library through service agency,letting users themselves search and select appropriate SLA template. Once the main elements of SLA were agreeed, customers and providers can choose third-party entities SLA to monitor.They mainly executive the distrustful fuctions or the tasks that CP and users can't carried out. After completing negotiation, CP and users sign available SLA document, guiding service deployment.

Deployment Service is responsible for checking the effectiveness of SLA and allocated task to supporting entity. Supporting entity only need obtain related executable information of function.

In the operation of service, CP, users and third parties measure, assessment and management the service.

Management service is responsible for measuring real-time business performance according to the SLA parameters defined in the document in order to maintain the current system's configuration and operational information.We here put forward common SSLA parameters in cloud comuting.1) Usability:Easy built-in user interfaces 2) Availability:Uptime of software for users in specific time 3） Reliability :ability to keep operating in most cases4） Scalability:Using with individual or large organisation 5) Customizability :Flexible to use with different types of users.

Evaluation services is responsible for evaluating the consistency degree between SLA parameters monitored at runtime and SLO signed.It get the evaluation results through compared the threshold defined in SLA with SLA parameters measured.

Assessment services sent report to CP and users. Due to the dynamic characteristic of cloud resources, we will establish dynamic scheduling mechanism. It doesn't like the network services. For example in the cloud computing circumstances, the enterprise has a large amount of data transmission and load fluctuation and SLA violation during transmission may occur frequently. Then we can schedule evaluation according to this index, checking runs frequently.

Once the assessment service reports generated not reached SLO or SLA violations and rules exception happened, SLA compensate and take corrective actions and then embodied in the billing services. After assessment service terminating, the whole service ends. It will restart the SLA development.

4 Conclusion

In CSLA model, we can see a clear formal SLA mechanism. Cloud service provider can clear the needs of users, using cloud resources utmostly. Users can guarantee service quality and obtain corresponding rights and compensation when the interests of cloud is encroached.

With many companies beginning to use cloud service, cloud computing standards missing problem are more and more prominent. SLA's effective application still need relevant laws and regulations and the standardization of SLA which is on the basis of standardization of cloud service and the safety control to safeguard. When a CP's resource are constrain, task will be moved to another CP's resources so that avoid SLA violations. In migration process standard agreement is the guarantee of quick deployment and the foundation of expansion. Therefore cloud computing standard is also one of the future work.Also, in cloud computing's SLA management, SLA charging strategy, SLA dynamic monitoring are the key technologies of the future study.

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The Development of PLC Innovative Experimental Platform and Study on Experimental Teaching

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Abstract. At first, in this paper the necessity of the PLC experimental teaching model transformation and integrating were analyzed, a set of PLC innovative experimental platform was developed by the use of the teaching models and by combining with network technology and configuration technology. A complete system overcomes lack of flexibility of many experimental equipment from the current some experimental equipment manufacturers, and increases students' initiative.It does a specific purpose.

Keywords: Teaching model, Network, Communications, Configuration monitoring.

1 Introduction

Electric control and the technology of PLC play an extremely important role in industrial automation. Practice links of this course are essential, through which practical operations can be conducted and students can really grasp electric control and the technology of PLC. Previous controlled experiments require authentic controlled plants. However, material objects are generally characterized by bulky, expensive, difficult to maintain, etc. And they are quite difficult to be equipped in laboratory. For the present situation, although PLC experimental models of huge capital investment are equipped in laboratory, such as manipulator model, material sorting model, stereoscopic warehouse model, car model, trolly cranes model, elevator model and so on, the utilization ratio is still quite low and every model tends to be independent. Due to the small number of models, which is not suitable for carrying out experiment, and relatively easy control, they are left unused for most of the time.

The PLC experimental teaching model transformation, integrating and the development innovative experimental platform are able to increase comprehensive, creative and innovative research experiments, as well as to introduce "compulsion", "option" and "progression" to experimental programs, so as to conduct individualized teaching, meet students' interests and inspire their innovative thoughts. Establish a more open management of laboratory in order to make PLC laboratory an important base of students for conducting creative activities of extracurricular research and study.

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To provide a superior platform for electrical engineering and its automation, as well as for undergraduate curriculum design, diploma project, extracurricular creative activity,graduate cultivation, teacher's scientific research of agricultural electrification and automation.

The PLC experimental teaching model transformation, integrating and the development innovative experimental platform firstly blend teacher's understanding of knowledge into experimental content, basing on the principle of actual needs in teaching. The teaching of knowledge requests a special carrier. This is the experimental model suitable for teaching. Secondly, at present, the drawback of some experimental equipment manufacturers is the lack of flexibility, which does not meet the direct requirement of practice teaching. In addition, it makes students less initiative in study. Thirdly, the majority of college students think that the experimental teaching model of this course is so single and low efficiency that it is not beneficial to the ability cultivation of analysing and solving problems, neither to the inspiration of creative thoughts. The PLC experimental teaching model transformation and integrating are able to make the best use of everything.

2 Hardware Design of Experimental Platform

2.1 Object Teaching Model of the THWJX-1 Manipulator

The mechanical structure of object teaching model of THWJX-1 manipulator consists of ball screws, slide bars, air cylinders, air clips and other mechanical parts; electric aspect of the structure is composed by stepping motor, stepping motor driver, sensor, switching power supply, electromagnetic valve and other electronic devices; the programmable controller is Mitsubishi PLC.

Fig. 1. Object teaching model of the THWJX-1 manipulator

2.2 Object Teaching Model of Material Sorting

The mechanical structure of object teaching model of the THFCL-1 material sorting consists of conveyor belts, air cylinders and other mechanical parts; the electric part is composed by sensor, switching power supply, electromagnetic valve and other electronic devices. It adopts the desk-top structure, built-in power supply and Mitsubishi PLC host machine. Colour recognition sensor is employed in this apparatus, as well as capacitance and inductance types of sensors that are sensitive to different materials. In addition, this apparatus sets up pressure reducer, filtration, air pressure instruction and so on in terms of pneumatic power.

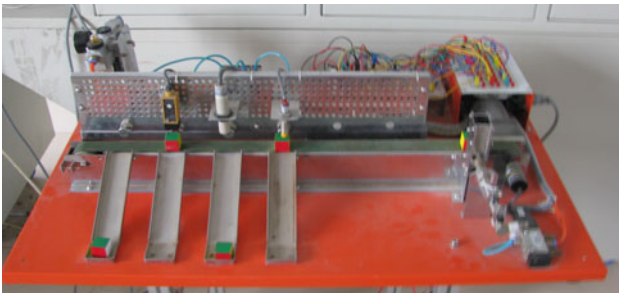


Fig. 2. Object teaching model of the THFCL-1 material sorting

2.3 Object Teaching Model of the THFLT-1 Stereoscopic Warehouse

The object teaching model of the THFLT-1 stereoscopic warehouse is constructed mechanically in the manner of screw transmission. In electrical control, PLC that output by transistor collects all kinds of signals from sensors and conducts complex positioning control and sequential logic control to stepping motor and DC machine, so as to accomplish freight space locating and delivering/fetching operation (axis X or Y for freight space locating, axis Z for delivering/fetching operation). This model can realize such experimental functions as delivering goods on axis Z to the designated location, delivering goods in any position to another position, delivering goods in the Zero position to any position, fetching goods from any position to the Zero position, functioning in the mode of low rate start—variable speed operation—low speed parking, scan detection of $0\sim12^{th}$ freight space and so on.

Fig. 3. Object teaching model of the THFLT-1 stereoscopic warehouse

2.4 Network Link of the Experimental Platform

The schematic diagram of experimental platform's connection is illustrated in Fig 4[1~4].

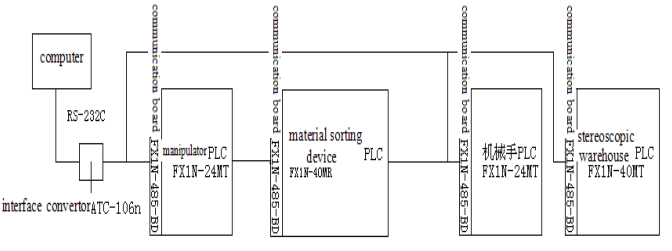


Fig. 4. Schematic diagram of experimental platform's connection

3 Communication Design of the Experimental Platform

3.1 Method of Communication among PLCs

Hardware connection. There are four sites in this production line. Site 0: Mitsubishi FX1N-40MT. Site 1: Mitsubishi FX1N-24MT. Site 2: Mitsubishi FX1N-40MR. Site 3: Mitsubishi FX1N-24MT. Fix communication modules of Mitsubishi FX1N-485-BD to PLC of each site in the network, and connect three modules together by shielded twisted pair(the cable mode needs to be AWG26-16, with a maximum tightening torque of 0.6N.m(6kgf.cm)) as shown in Fig 5[5,6,7].

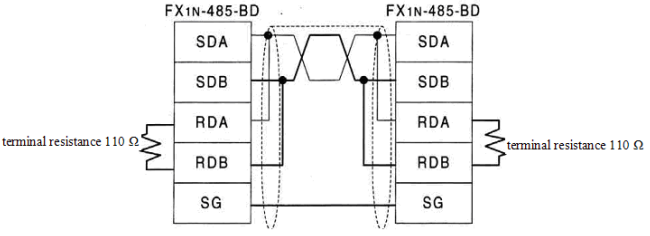


Fig. 5. Communication link among PLCs

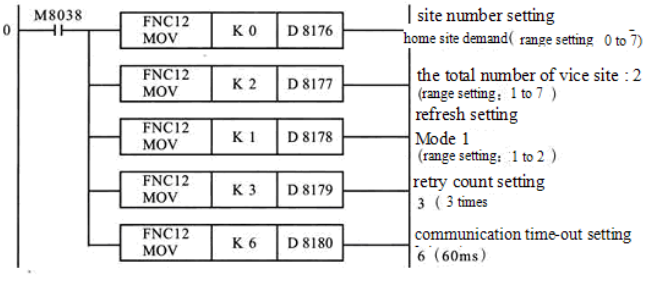
PS: 1. Terminal resistances added only to both ends of the network (i.e. Site 0 and the site with the largest number).

2. Shielding layer of shielded twisted pair on the side FX1N-485-BD needs to be earthed.

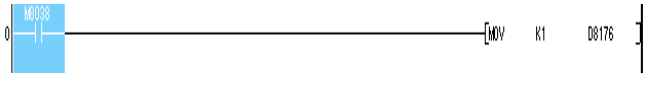
3. SG be earthed.

3.2 Web Site Programming

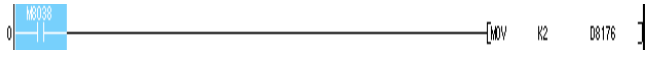
Site 0:


M8038
FNC12 MOV K 0 D 8176
site number setting
home site demand(range setting 0 to 7)
FNC12 MOV K 2 D 8177
the total number of vice site : 2
(range setting: 1 to 7)
FNC12 MOV K 1 D 8178
refresh setting
Mode 1
(range setting: 1 to 2)
FNC12 MOV K 3 D 8179
retry count setting
3 (3 times
FNC12 MOV K 6 D 8180
communication time-out setting
6 (60ms)

Site 1 :



Site 2 :



Site 3 :

The communication mode of the network is Mode 1. In this mode, bit elements and byte elements shared by all sites in the network are as follows:

Site number	soft element number	
	soft bit elementM)	soft byte element(D)
	32 points	4 points
site 0	M1000to M1031	D0to D3
site 1	M1064 toM1095	D10to D13
site 2	M1128 to M1159	D20 toD23
site 3	M1192 to M1223	D30 toD33

4 Interface Design of Configuration Monitoring

Principal computer connects with the home site which is also Site 0. Other sites transmit the running state of this site to the home site through its shared bit elements. Thus, principal computer has access to running states of all sites by reading informations of the home site. Principal computer can achieve on-site monitoring and controlling by using the Kingview software of Wellintech Co., Ltd[8].

4.1 Communication Setting

Communication parameters setting of the Kingview software is illustrated in Fig 6.

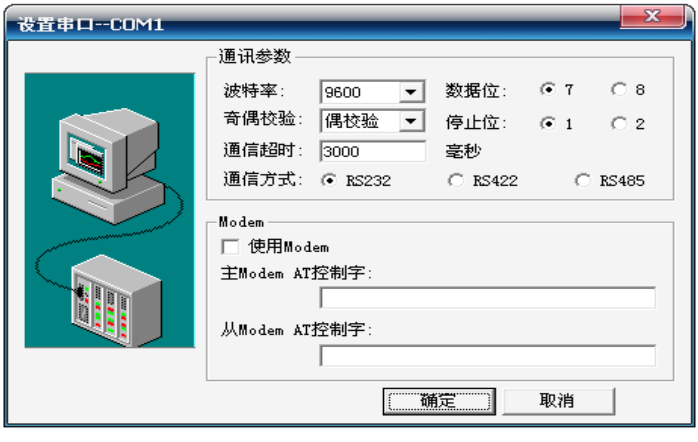


Fig. 6. Communication parameters setting of the Kingview software

4.2 Screen Design of Configuration Monitoring

Fig 7 shows the final interface.

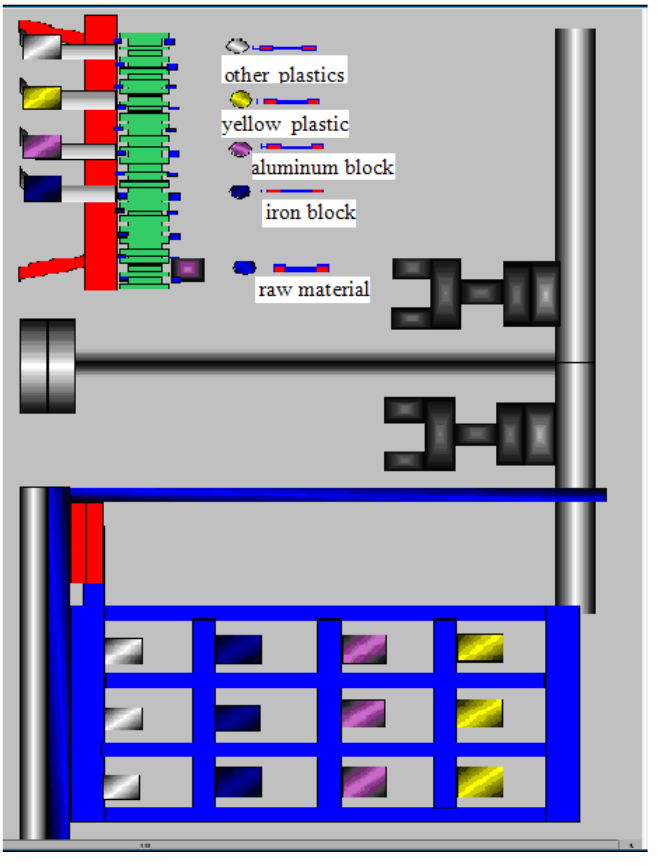


Fig. 7. Interface of configuration monitoring

4.3 Script Programming

```
Start:
    \\site\conveyor belt range ability = 0;
    \\site\horizontal shaft move = 0;
    \\site\longitudinal shaft move = 100;
    \\site\mechanical fetching arm = 1;
    \\site\vertical move of object = 0;
    \\site\horizontal move of object = 0;
    \\site\transverse feed of platform = 0;
    \\site\length feed of platform = 0;
    Running :
    if (\\site\conveyor belt move = 1)                    //material sorting command language
    {\\site\conveyor belt range ability = \\site\conveyor belt range ability +1;}
    if (\\site\conveyor belt move = 0)
    {\\site\conveyor belt range ability = 0;}
```

```
if (\\site\object's ascent = 1)
{\\site\vertical move of object = \\site\vertical move of object +1;}
if (\\site\warehouse object's ascent = 1)
{\\site\vertical move of object = \\site\vertical move of object +1;}
if (\\site\object's right shift = 1)
{\\site\horizontal move of object = \\site\horizontal move of object +1;}
if (\\site\warehouse object's right shift = 1)
{\\site\horizontal move of object = \\site\horizontal move of object +1;}
if (\\site\electromagnetic valve of cutting cylinder = 1)
{\\site\vertical move of object = 0;
\\site\horizontal move of object = 0;}
```

5 Conclusion

Following objectives can be achieved through the design and the development of experimental platform.

5.1 Establish a Curricular System of " Two Platforms and One Thread"

First of all, gather together knowledge points of the course "Principles and Applications of PLC" to build two knowledge platforms. The first is the experimental platform of PLC, which not only aims at equipping students with basic structure, working principle, basic logic instructions, parts of advanced instructions and simple methods for practical use, but also aims at establishing an overall concept of PLC controlling system and basic designing approaches for students to finish some simple designs. The other is the platform of PLC emulation model and innovative experiment, with the main purpose of cultivating student's ability of further studying and deepening knowledge points. It lays emphasis on simulation control, communication function and system design, as well as comprehensive application (engineering-oriented). During the learning process of the two platforms, the cultivation of practice ability, as the thread of the whole process, optimizes internal relations of practice contents that focusing on level, relevance, graduality and integrity, so as to realize the transition from operational and single experiment to design-oriented and comprehensive experiment and finally the transition from technical foundations to engineering. The curricular system of "two platforms and one thread" gives full play to the cultivation of comprehensive designing ability, innovative design ability and practicing ability of engineering throughout the whole teaching process.

5.2 Multi-level "Stereoscopic" Teaching Mode

To establish a systematic stereoscopic teaching mode and acquire advanced teaching concepts by realizing the stereoscopic teaching system, teaching materials of experiment, teaching methods, and teaching means as well.

1) Stereoscopic teaching materials: Provide a whole set of system that composed by main textbooks, reference books and programming platform in order to construct an organic unity of teaching resources which is mutually supplementary and

supportive and enable students to carry out experimental studies both of classroom and extra-curriculum anytime and anywhere.

2) Stereoscopic teaching methods: Carry out discussion-based teaching, interactive teaching, as well as research and inquiry-based teaching.

3) Stereoscopic of teaching means: Provide students with a favorable autonomic learning environment by opening laboratories.

5.3 Grasp the Key Point of Subject and Focus on Cultivating Capability of Practice Application

Considering features of special fields and needs of enterprises, the PLC experimental teaching model transformation, integrating and the development innovative experimental platform are able to increase comprehensive, creative and innovative research experiments, as well as to introduce "compulsion", "option" and "progression" to experimental programs, so as to conduct individualized teaching, meet students' interests and inspire their innovative thoughts. Build a complete system in terms of practice teaching content so as to equip students with capability of self-learning, as well as capability of analyzing and solving problems. Provide a superior platform for electrical engineering and its automation, as well as for undergraduate curriculum design, diploma project, extracurricular creative activity, graduate cultivation, teacher's scientific research of agricultural electrification and automation. Enable students master basic knowledges and theories of electric control, as well as basic approaches of designing PLC control system in a relatively short time. The most remarkable breakthrough is overcoming the drawback of lacking flexibility of experimental devices designed by manufacturers, which fails to meet the direct demand of practice teaching. In addition, the ability of self-learning for students is improved.

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Optimization of Power Consumption for Wireless Sensor Networks

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Abstract. Transmission using excess power not only shortens the lifetime of sensor nodes, but also introduces interference. Packets should ideally be transmitted with moderate power. This work proposes a multi-level power adjustment (MLPA) mechanism for a wireless sensor network to prolong the lifetime of individual nodes and the overall network. An analytical model of the MLPA mechanism with m distinct power levels (m-LPA) is constructed. For 3-LPA, the closed-form expression of the optimal power setting is determined and the mean transmission power is minimized to one third of original fixed power. Besides, we found that average power consumption of our proposed mechanism is 47% higher than original. Thus, each node can extend 2.5 times of life time. And we shown the relations between m and density in simulation result.

Keywords: Sensor node, lifetime, multilevel power, wireless sensor network.

1 Introduction

Power-consumption issues have become one of main topics in current wireless sensor networks (WSNs) research. In the past few years, there has been much improvement on technology and application of wireless sensor networks. There are complete standard in real case, ex. IEEE 802.15.4 and Zigbee, etc., and wide range of applications including home security, firm industry, health care, military and many other fields. In those cases, each sensor has limited power and computing resources. Therefore, it's a major issue to prolong network lifetime for wireless sensor networks.

There are three basic subsystems on sensor node: a sensing subsystem to collect data from environment, a processing subsystem to provide computation ability to the sensor node, and communication subsystem for transmission data. These subsystems are all limited by sensor node power inside. Each sensor node plays their part to perform sensing, computing or transmission in limit energy. Sensor node consumes the most of power in transmission. In order to extend the life time of WSN, we propose a power control mechanism to achieve an efficient sensor data transmission by using adaptive transmission power rate for packet routing, and prolonging the life time of sensor.

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2 Related Work

Various approaches for determining the transmission range to extend WSN life time have been proposed in the literature [3]. Conventional WSNs (wireless sensor networks) consist of thousand of sensor nodes and sensors that can communicate with each other or base stations (BS). The coverage area of a WSN depends on the number of sensors deployed [1].

In recent years there were many researches not only majored in data collection and processing of the sensor but also the coordination and management of the sensing issue. Due to the limitation of the electricity power and the communication bandwidth of the sensor node, it is necessary to design a technology to reduce the waste of power and employing the limited bandwidth effectively. The limitation in traditional WSNs causes many challenges of design and management such as the issue of electric power by each layer of network protocol stack. For example, it is necessary for the network layer to use a well power-saving routing method that sends data from sensor node to base station effectively and increases the network life time.

The routing methods of current WSNs included table driven, demand-driven, and hybrid. whereas at least three methods for solving problems of data transmission and electrical power are based on routing, some approaches solving such problems by exploiting communication among sensor nodes. They try to adjust the communication power according to distance of transmission, but they have to solve problems of unknown transmission distance, uncertain range of sensor node coverage, and non-linear deployment in real WSNs.

Because of these uncertainties and other unknowns, real WSNs cannot easily compute the precise communication power, even though some investigations have presented the optimization algorithm. This work proposes a power-adjustable routing policy, in which no sensor node transmits data by static communication power. Rather, each sensor node transmits data using dynamic communication power, determined by the distance to the adjacent node or the conditions of the immediate environment.

3 Multi-Level Power Adjustment

Generally, the required transmission power is the same for the communication of all sensor nodes with their neighboring nodes. Consider the example of an WSN shown in Figure 1. The distances between two pairs of sensor nodes differ, but the power consumed in sending data for one to another is the same for each pair. Consequently, the energy efficiency is unsatisfactory, because even if two sensor nodes are so close to each other that data can be transmitted using half the communication power (such as nodes c and d in Figure 1), the traditional method still transmits using the full communication power.

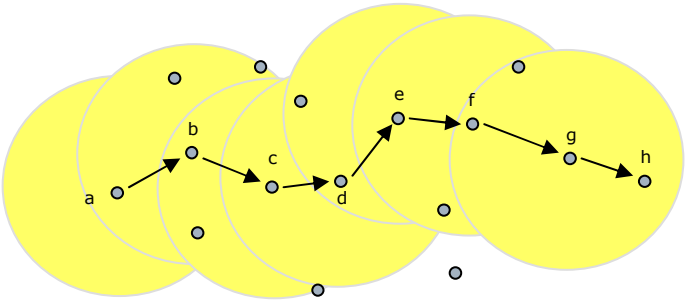

Fig. 1. The situation of data transmission power in traditional WSNs

Adjustable transmission power is not a new concept. Lin *et al.* [4] presented adaptive transmission power control (ATPC) for WSNs, where each node constructs a model for each of its neighboring nodes that describe the relationship between transmission power and link quality. A feedback-based transmission power control algorithm is utilized to maintain individual link quality over time dynamically.

This work presents a Power Adjustment Table (PAT) for every sensor node to determine the optimal communication power dynamically. Using the PAT, every sender node determines the communication power that is required to transmit data, based on the environment of the nearby receiver node, to reduce the power consumption. Accordingly, the WSN lifetime is extended. After the adaptive communication power is determined as in Figure 2, each sender node uses a particular communication power to transmit data that is consistent with the environment of the nearby receiver node.

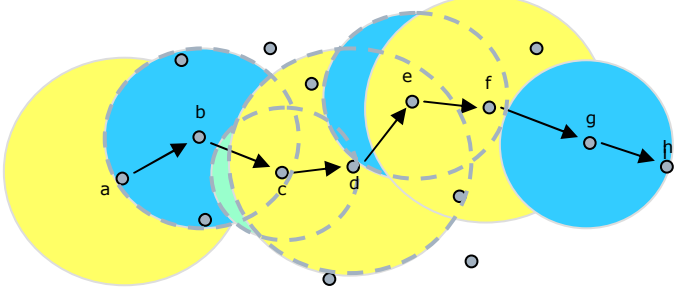

Fig. 2. The data transmission after determination of the adaptive communication power

3.1 MLPA Mechanism

In the proposed MLPA mechanism, each sensor node has a transmitted with adjustable power. The key feature of MLPA is the use of just enough power to communicate with neighboring nodes. Less power is used for closer nodes. The MLPA mechanism has the following three phases.

1) Phase I: Neighbour discovery and construction of network topology

Initially, each node broadcasts a beacon to identify all possible neighboring nodes. Full transmission power is utilized to maximize the network connectivity level.

2) Phase II: Negotiation and adjustment of transmission power negotiation

Energy is conserved by reducing the average transmission power. Full power is not required to transmit to a nearby neighbor. In phase II, a sensor node negotiates with its neighboring nodes and determines which power level to be used for each neighbor. Given the negotiation overhead, the piggyback mechanism can be used to reduce the overhead from power negotiation.

3) Phase III: Runtime maintenance

The communication environment may change dynamically after node deployment. Additionally, the movement of nodes may change network topology. Sensor nodes must repeat phases I and II to update the network topology and preserve the optimal power assignment for each neighbor.

3.2 Construction of Power Adjustment Table

Initially, each sensor node is assumed to have the ability to adjust its own power adjustment. Theoretically, transmission power can be separated into n portions, but this approach is not very useful for the purposes of this work. In this work, transmission power is separated into three portions, which are L, M and S. Figure shows the coverage of these three portions of transmission powers.

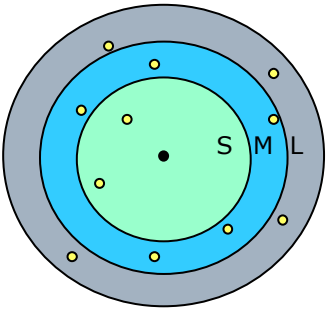

Fig. 3. Different Transmission Power with Different Signal Coverage

Each sensor node transmits these three powers in the WSN initial stage and tries to sense other neighbor sensors in its coverage area. These data are stored in a table like that below.

Table 1. Example of PAT table in Sensor node

Neighbor node	Transmit power	alive	Response
a	L	1	1
j	M	1	4
e	M	0 (dead)	
g	M	2 (sleep)	3
f	M	1	4
i	S	1	1

Through this PAT table, we are able to determine a node's neighbor node, transmission power consumption, the operating (alive) status of the node and the response status of the node. A sensor node can optimize transmission power using this PAT table to complete transmission.

Assumption PAT table of node k is shown in table 1. When node k receives data from node i, node k already knows that the next node is node j. Hence, node k uses level M transmission power to transmit data to node j, after it queries the PAT table for node k.

4 Simulation

A simulation program was written to confirm the multilevel power adjustment (MLPA) mechanism; static transmission power and transmission under the MLPA mechanism were compared. Adjusting transmission power according to the proposed mechanism enables the packets to arrive at the sink node, but reduces the power consumption by almost half.

When the MLPA mechanism is applied, the transmission power is changed adaptively to deliver packets to the next node. The routing protocol is assumed to be table-driven. The sensor node looks up the routing table when it routes data. If the next node does not listen at the same time, then it has to decide whether to change the next node. In the simulation, DSDV [2] is used as the routing protocol. The proposed mechanism is compared to the one that uses static transmission power.

To determine the efficiency of the MLPA mechanism, a simulation was performed using Visual C++. The sensor area is set to 600×600 m^2. The number of deployed sensor nodes was 200 to 900. The transmission range of the sensor was 50 m. When the simulation ran, if the number of sensor nodes was under 200, the sensor network could not maintain its network connectivity and some regions failed to be covered. Therefore, at least 200 sensor nodes are needed to achieve network function.

In this paper, we refer to T-mote sensor to be set senor power parameter. The packet generation probability is assigned in accordance with Possion probability to generate. In the simulation, We compared MLPA mechanism(m=2 to 9) with the traditional mechanism which is only using simply a kind of power to deliver information (m=1). In Figures 4 and 5, they show that we saved an average of more than 47% of the average power consumption in Figure 4 low-density group (number of nodes between 200 to 500), and we saved an average of nearly 62% of the average power consumption in Figure 5 high-density group (number of nodes between 600 to 900).

Figure 4 shows the average power consumption for greater impact when $1 < m < 6$. Transmission power of the m value of each additional layer, the average power consumption will have a more significant decline, when $m > 6$, the change will slow down.

However, Figure 5 shows the average power consumption for greater impact when $1 < m < 3$. When $m > 3$, this change was slowed down with the same rate.

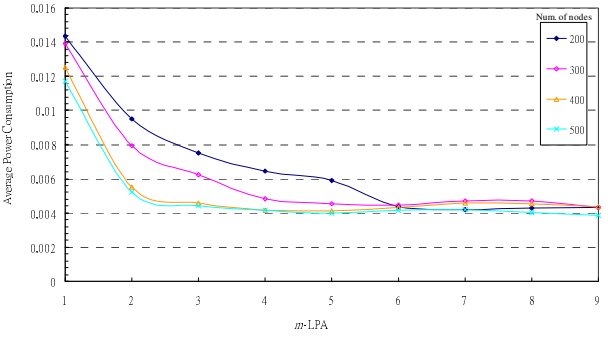

Fig. 4. Average power consumption for m-LPA (200 – 500 nodes)

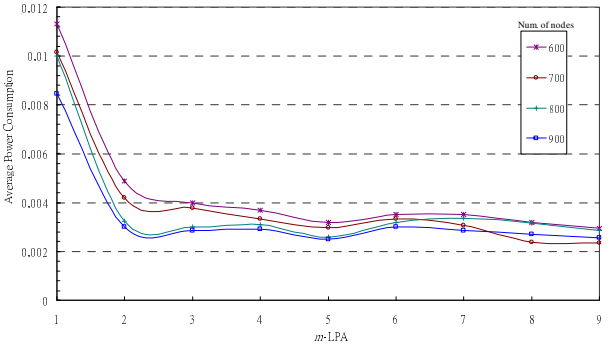

Fig. 5. Average power consumption for m-LPA (600 – 900 nodes)

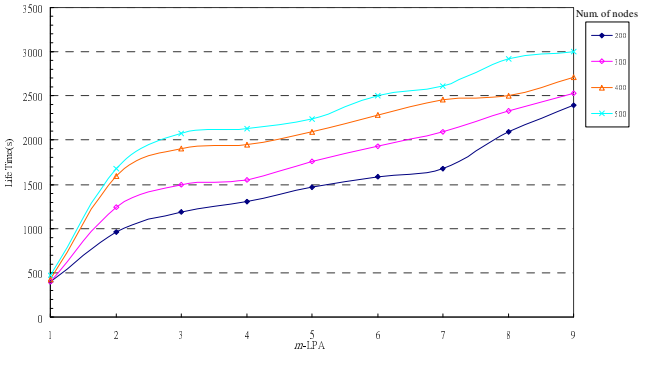

Fig. 6. Life time of WSN with m-LPA (200 – 500 nodes)

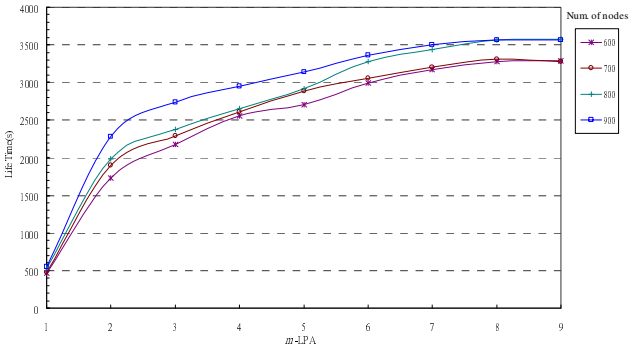

Fig. 7. Life time of WSN with m-LPA (600 – 900 nodes)

Figures 6 and 7 show the life time of traditional mechanisms of 1-LPA are not long. We compared the life time of MLPA mechanism with the 2-LPA and 1-LPA, 2-LPA has an average extension of 2.5 times the of the life time. In Figure 6, we can see that when the density of deployment is lower, MLPA mechanism ($1 < m \leqq 9$) can be extended for more Life time. And Figure 7, when $1 < m < 3$, Life time get more extension. When $m > 3$, the increasing of Life time is slowed down.

Figure 8 from the next chart, we can also understand the impact of the density for the life time. 1-LPA's performance is far below to other m-LPA ($m > 1$) performance. And when the density is less than 0.17 and $m > 4$, Life time performance is quite remarkable, but density greater than 0.17 and $m > 4$ the following, Life time curve is flat. For different density environment, generally increasing the m value will enhance and improve the life time of whole WSNs. However, the higher the density, the smaller improvements of life time. Figure 8 shows the performance will tend to close, when $m = 8$ and 9 in the density greater than 0.17.

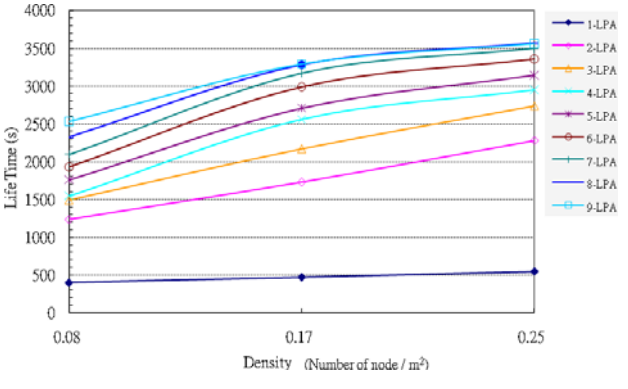

Fig. 8. Life time of WSN with Density

Therefore, the setting for the *m* value to the environment must consider the density of deployment. Generally speaking, $m = 2$ or 3 can get pretty good performance, but the higher the density of deployment, the *m* value will be set too high and not getting a better result.

5 Conclusion

Reduce energy consumption and increase the overall Life time has been the subject of concern to the field of WSN. We also studied other solutions for these problems by other proposed method. Which is control of the energy transmission can be calculated by distance to get the accurate transmission of energy. However, most theoretical calculation for the transmission of energy is very difficult to achieve in the real world WSN environment. Because in the real environment, the Distance Information and the environment from all kinds of interference factors are difficult to predict and measure, so it is difficult to implement these mechanisms to the actual environment. We proposed a MLPA mechanism to implement in real WSN environment. Base on PAT table construction, appropriate transmission power is able to be adjusted during data transmission. We found that average power consumption of our proposed mechanism is 47% higher than original. Thus, each node can extend 2.5 times of life time. And we shown the relations between *m* and density in simulation result, and Set the appropriate *m* value will improve life time performance.

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New Concept for Ocean Trestle Facility in High Tide Region

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Abstract. The western coast in South Korea is characterized as high tide range up to 10m that restricts the duration of access to the loading facilities in the region. Especially the major harbor in Incheon has big disadvantage to invite the major shipping lines. It is critical condition if the ships need to wait to offload and load cargos to meet the required water depth losing time and chance to operate the ship. Also the shallow water depth in the region restricts the size of vessel for navigation and berthing. With more than 70% of trade logistics in South Korea has concentrated in the Seoul metropolitan area where there is Incheon harbor as the main trade gate. The quantity of trade in Incheon harbor has been increased annually with the fastest-growing trade volume between Korea and China. The new concept in the paper can overcome these problems without massive civil work that causes the environmental impact filling the water like dredging. The breakthrough idea in the paper will suggest the solution for offloading facilities in the areas with high tide range securing 24 hour access.

Keywords: Ocean trestle, berthing facility, high tide, offloading, intelligently controlled trestle.

1 Introduction

Incheon harbor in the western coast of Korea is of the major trade logistics in Korea. The quantity of trade in Inchoen harbor has been increased annually with the fastest-growing trade volume between Korea and China. It has been announced as the gateway hub harbor for the international trade in the East Asia. To confirm the hub harbor and to enhance the competitiveness over other major ports, it is required to improve the harbor facilities. However, Incheon area is characterized as the high tide range of up to 10m that restricts the accessibility to the loading facilities. It is critical condition if the cargo ship is to wait for high tide for offloading. Other disadvantage of the area is the shallow water depth that also restricts the size of vessel for operation. The conventional harbor construction method with dredging and land reclamation requires very high construction cost and generates adverse environmental impacts. The roles and limits of Incheon harbor are described in the reports [1]. Jo et al. [2] has performed the concept research of harbor berthing facility and trestle

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facility coping with large tidal difference. To accommodate large vessel in high tidal region without environmental impact, the new concept and breakthrough idea called as ABTF (Adjustable Berthing and Trestle Facility) is introduced in the paper.

2 The Features of the ABTF Concepts

The ABTF is can be controlled actively with the intelligent control system that can adjust the berthing elevation according to the sea level with draft control. The ballasting tanks can intake and discharge the water ensuring the draft that can accept the cargo ships any time regardless of tide range.

The intelligent buoy trestle has pontoon with several ballasting tanks that can adjust the level and incline angle so that it can connect the bridge and berthing system in real time as per the change of sea level. The combinations of the above two components make ABTF complete system to meet the requirement in regions with high tidal range as shown in Fig. 1.

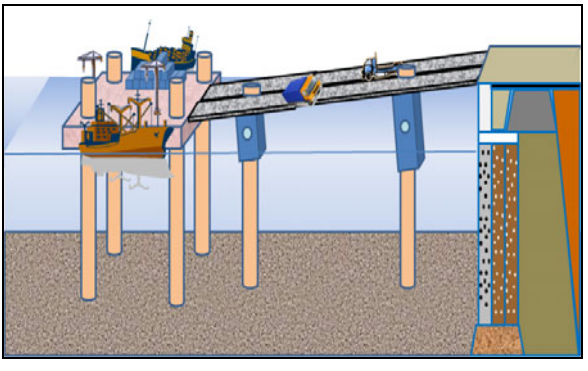

Fig. 1. ABTF system concept

3 Characteristics of the ABTF system

The ordinary berthing facility is a concrete caisson vertical structure expended to the enough water depth for offloading that often requires dredging of the region. The level of the ABTF berthing body can be adjustable as per the change of sea level along the vertical piles. Its level keeps changing together with the unloading cargo vessel as per the real time sea variation. The draft of the floating body can be changed by water intake or discharge inside the divided ballasting tank. Also the ballasting tank has the anti-rolling control system.

The intelligent trestle system can adjust the bridge level by travelling the vertical pile with the function of controlling the inclined angle by the intake and discharge in the divided ballasting tanks. The intelligent buoy trestle can resolve the problems that the ordinary pin trestle facility has.

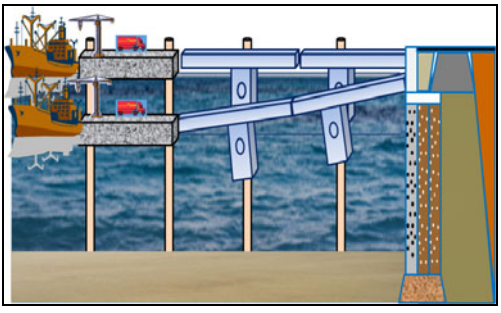

Fig. 2. Intelligent trestle facility

Other application of the intelligent trestle is to minimize the distance between land and the floating berthing structure with combined motions including inclination and elevation. This application could be effective where the distance between the berthing body and the buoy trestle is limited. This type of operation can be situated during the maximum low tide period that would require very long trestle distance for operation under the allowable incline angle.

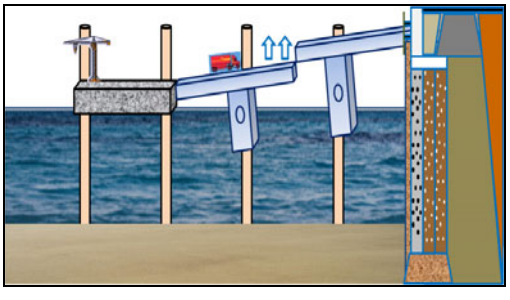

Fig. 3. Utilization of intelligent buoy trestle in a short length situation

The ABTF system has two parts; floating berthing body and intelligent trestle that can eliminate the dredging and reclamation of land. This system can reserve the important coastal regions from environmental damage. Also the ABTF system can be applied to extend the existing harbor to accommodate larger vessels without extending reclamation. This would be the most cost effective and nature friendly method to extend the harbor.

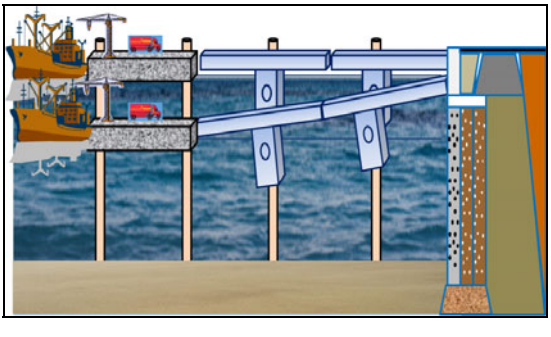

Fig. 4. Extension of exiting harbor

4 Application

Considering the container truck of 13.1ton with the maximum loaded weight of 31ton, the 30m bridge would be under 174ton load. The stress and deflection of the bridge can be calculated as in Table 1.

Table 1. Bridge thickness and stress and deformation

Bridge thickness (cm)	stress(MPa)	deformation (m)
1	1,631	4.49
2	448	0.62
3	217	0.2
4	133	0.09
5	92	0.05
6	68	0.03
7	54	0.02
8	43	0.01

The intelligent trestle system has 30m bridge and 7m buoy structure as shown in Fig. 5.

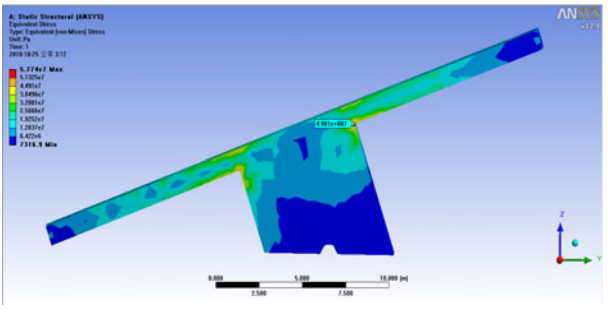

Fig. 5. Intelligent trestle system

As the awareness of importance of nature has been growing, the nature

5 Conclusions

As the awareness of importance of nature has been growing, the nature friendly developments and methods are highly required in harbor constructions as well. The ABTF system is a new concept that can be applied to the harbor construction and to the extension minimizing environmental damages. Other advantage of the ABTF system is it application to the high tidal range region like on the west coast of Korea where there is more than 10m sea level change. To accommodate large cargo vessel, the shallow water channel and

berthing area are to be dredged causing extensive cost and environmental damage. The ABTF system can eliminate these problems and can be the future solution to cope with increase of trade in the region of Inchoen, Korea.

Acknowledgements. This paper has referenced the final report of Minister of Land Transport and Maritime Affairs (2009) and supported by Hyundai E&C Inc. and Inha University.

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Steganalysis of Data Hiding in Binary Text Images Based on SVM and Run-Length Statistic

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Abstract. The embedding algorithm which hide information by flipping block central pixel is the most practical and transparent method of the binary text image embedding algorithms. According to the change of binary text image run statistical regularity caused by data hiding, a new blind steganalysis method aimed at this kind of data hiding method based on support vector machine and secondary data hiding is presented in this paper. Experimental results show that, under the condition of less training samples higher synthesis test accuracy of the steganalysis for Yang's and Wu's data hiding methods can be realized by this method.

Keywords: Steganalysis, binary text images, run-length statistic, support vector machine.

1 Introduction

The main purpose of the steganography is to hide important information, so as to transmit and store information unperceived. Whether for commercial confidential communication or for military communication, steganography is a kind of secret communication technology with good application prospect. Steganalysis is the reverse process of steganography, which can not only prevent the secret broadcast of illegal information, but also facilitate the generation of more secure steganography algorithm, so it has attract more and more attentions.

The widespread uses of text files in reality accelerate the development of text image processing and text information hiding. At home and abroad, many researchers have carried out researches on binary image steganography, and some binary image steganography algorithms with high performance are proposed. Due to the character of the text image that it has only white pixel and black pixel, the redundancy of the image is less, so it is difficult to hide information in the text image. The algorithms with good synthesis effect are based on central pixel flipping[1-4] and Coding transformation[5] (CT), among which the typical algorithms with best visual effect are Yang's embedding algorithm based on connectivity and Wu's embedding algorithm based on block mark.

The invisibility of information hiding and the correct detection rate of steganalysis are paradoxes. The higher invisibility the higher challenge for steganalysis, and so the present steganalysis algorithms mainly focus on the steganography of flipping block central pixel, which is the Yang's and Wu's steganalysis algorithm. The increase of

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the roughness and the complexity after steganography is utilized to detecting the secret information of document images in [6]. The disadvantage of the method is that it has high detection probability only when the hiding information change the image obviously, which is only applicable to detect the stego image based on CT. A blind detection method of the document image information aiming at block central pixel flipping based on the gravity center distribution law of the image and COL (centers of L-shape patterns) pixel sets is proposed in [7]. It can effectively detect the stego image based on Yang's and Wu's embedding algorithm. Although with high global detection rate, the algorithm has no capability of self-learning. Moreover, the performance of the algorithm is sensitive to threshold, which is difficult to determine and has the limitation. The algorithm in [8] is also a blind detection method aiming at block central pixel flipping, which can also effectively detect the stego image based on Yang's and Wu's algorithm. Since the algorithm is realized by determining the threshold of unvaried statistics through experiments, it should classify and analysis the image according to the typeface, and set different threshold for various image sets. The process of the experiment is complex and impractical. A kind of video steganalysis algorithm based on SVM is designed in [9], and good results are obtained.

A new binary text image steganalysis algorithm aiming at Yang's and Wu's embedding algorithm is proposed in this paper. Firstly, the secondary random steganography is carried out on the image to be detected. Then the characteristic parameters of the four run length between the original image and the secondary secure steganographic image are calculated as characteristic vector. At last, the blind steganography detection of the binary image is realized by using SVM as the classifier between the original image the secret image. The algorithm needn't classify the image and it has the ability of self-learning. The experimental results indicate that with less training set the synthetical test accuracy for Yang's algorithm of the steganography can achieve 100% and the synthetical test accuracy for Wu's algorithm of the steganography can achieve 97%.

2 Run Analysis of Binaryy Text Image

2.1 Several Related Concepts

An image F with size of $M \times N$ is scanned according to the row and column respectively to a sequence of binary vectors. The scanning vector of the column is denoted as H and the scanning vector of the row is denoted as L. Both lengths of the sequences are $l = M \times N$.

Definition 1: The frequentness of *k* run means the probability of the data bits belong to *k* run in the sequence, which is represented by $f(k)$.

$$f(k) = \text{number of } k \text{ run} \times k / \text{sequence length} \tag{1}$$

The difference between the run frequentness statistic function of two images F and F^* with same size is defined as:

$$d = \sum_k d_k = \sum_k | f(k) - f^*(k) | \tag{2}$$

$f(k)$ and $f^*(k)$ are run frequentness statistic functions of images F and F^*, k is the run length.

Definition 2 : The frequency of *k* run means the ratio of the number of *k* run to the number of the total run in the sequence, which is represented by g(k).

$$g(k) = \text{number of } k \text{ run/number of total run} \tag{3}$$

The difference between the run frequency statistic function of two images F and F^* with same size is defined as:

$$l = \sum_k l_k = \sum_k | g(k) - g^*(k) | \tag{4}$$

$g(k)$ and $g^*(k)$ are run frequency statistic functions of images F and F^*, k is the run length.

It is easy to see that the more random the row and the column scanning vector of image F and F^*, the smaller the corresponding values of *d* and *l*. If they are completely random, then $d = l = 0$.

Definition 3: The definition of the synthesis test accuracy is:

$$P_r = 1 - P_e = 1 - (\eta P_1 + \alpha P_2) \tag{5}$$

where P_1 is the ratio of the stego image to all images to be detected, P_2 is the ratio of the clean image to all images to be detected, η is the miss detection rate of the image to be detected, α is the false detection rate of the image to be detected.

2.2 Run Distribution Law of Binary Document Stego Image and Original Image

A part of pixels will be modified when information is embedded in image, which is equivalent to add noise into image, and must have an effect on run statistical law of image row scanning sequence and column scanning sequence. The embedding algorithm which hide information by flipping block central pixel is the most practical and transparent method of the binary text image embedding algorithms. The embedding algorithm which hides information by flipping block central pixel is to control the flipping of the central pixel which satisfies the condition of connectivity or has high value. The practical procedure is to make the pixels flip when the central pixel value of the information bit to be embedded and the qualified block are identical, and remain inactive when they are different. The block after flipping still satisfies the condition. Thus the randomness of the embedded information determines the randomness of the practical flipping point. We can think that this kind of flipping will random the run distribution in sequence affected by flipping point, and that is to

say the number of k run approach $1/2^k$(of course the number of the runs unaffected when flipping point is maintained). Based on above analysis we can deduce that: the difference of run frequentness statistical function as well as the difference of run frequency statistical function between the original image and the first steganographic image is larger than the difference of run frequentness statistical function as well as the difference of run frequency statistical function between the original image and the secondary steganographic image with large probability. Here the steganography algorithms are Yang's or Wu's steganography algorithms.

720 randomly collected binary document images in size of 512×512 are analyzed to verify the above deduction. The experiment results show that the distribution scope of the run frequentness statistical difference between the original image and the first steganographic image is [0.0019 0.0055], while the distribution scope of the run frequency statistical difference between the original image and the first steganographic image is [0.00037751 0.0025]. It is easy to see that the experiment result tally with the above deduction.

The above experiments verify our deduction, which means that the original image and the steganographic image can be effect linearly distinguished by the run frequentness statistical difference in definition 1 or the run frequency statistical difference in definition 2 through secondary steganography. At the same time it is obvious that there is a small overlap [0.0019 0.0025] between the two statistical scope. To using run frequentness statistical function or run frequency statistical function alone will lead to misjudge even though the probability of misjudge is small. In order to reduce the misjudge probability and make this kind of detection method popular, we design a new steganography algorithm. It takes the difference of the run frequentness statistical function and the run frequency statistical function under row scanning and column scanning as the support vector of SVM, and classifies the original image and the stego image through SVM. The detail of the algorithm can be seen in the third section. The experiment results in IV-A show that the algorithm can eliminate misjudge of singer variable detection, and gain effective analysis with less training sequences.

3 Steganography Analysis Based on SVM

3.1 SVM Classifier

The idea of SVM (Support Vector Machine, SVM) is proposed by professor N.Vapnik in the 1990's. It is a statistical machine learning theory under the condition of a little sample data, and is a kind of typical two classes' problem classifier. For given sample points $(x_1, y_1), \cdots (x_N, y_N), x_i \in R^n, y_i \in \{-1, +1\}$, where $\{x_i\}$ is the characteristic vector, constructing Euclidean space $wx + b = 0$ in characteristic subspace, so that $y_i(wx_i + b) \geq 1, i = 1, 2, \cdots, N$. Here the class interval is $2/\|\omega\|$, and to maximize the interval is equivalent to minimize $\|\omega\|/2$.

The training samples are correct separable, and the optimal classification is the classification minimizing $\|\omega\|/2$.The training samples points on the line $wx+b=\pm 1$ are called support vector.

On the assumption of linear separable, four vectors consisting of row scanning frequentness difference, column scanning frequentness difference, row scanning frequency difference, and column scanning frequency difference construct the characteristic vector. The best hyperplane is conformed according to the reference [10].For given sample space, the parameters w and b are determined. For given unknown samples, the class to which that x belongs can be judged only through the calculation of $\mathrm{sgn}(w\times x+b)$.

3.2 Steganography Analysis Algorithm

The algorithm is divided into two parts: the first part is to determining the hyperspace, which is also the procedure of training; the second part is the detection, which is also the procedure of steganography analysis, to judging the information is embedded in an image or not. The detailed realization of the algorithm is as follow:

The first step: Randomly select *n* binary original images with the same size of the image to be analyzed, and a set of binary stego images are got by embedding random information in the imaged with the same steganography algorithm of the image to be detected. Combine the original images and stego images into training image sets $\Psi=\mathrm{A}\cup\mathrm{B}$;

The second step: For $\forall F\in\Psi$, secondary stego images F^* are got by embedding random information in the imaged with the same steganography algorithm of the image to be analyzed. The set of F^* is denoted as Ψ^* ;

The third step: Calculate the difference of the run statistic function for arbitrary image in the sets Ψ and Ψ^* on (F_i, F_i^*) according to formula (2) and formula (4), to constitute the characteristic vector $X_i=\left(x_{1,i}x_{2,i}x_{3,i}x_{4,i}\right)$, $i=1,2,\cdots,2n$, where $x_{1,i}$ is the frequentness difference under the condition of row scanning, $x_{2,i}$ is the frequency difference under the condition of row scanning, $x_{3,i}$ is the frequentness difference under the condition of row scanning, $x_{4,i}$ is the frequency difference under the condition of column scanning.

The fourth step: For given training set $\{(X_i,y_i)\,|\,y_i\in\{1,-1\},i=1,2,\cdots,2n\}$, here X_i is the characteristic vector obtained in third step, when $F_i\in\mathrm{A}$, $y_i=1$ (it means there is no hiding information in the image), when $F_i\in\mathrm{B}$, $y_i=-1$ (it means there exist hiding information in the image).Use SVM to train the sample data, and calculate ω and b according to the method proposed in reference [10], then we get optimized hiperplane.

The fifth step: If the image to be detected is F_0, embed random information in the image with the same steganography algorithm of the images to be detected, then we get F_0^*.Calculate the characteristic vector of the image on (F_0, F_0^*), and calculate $y_0 = \mathrm{sgn}(wX_0 + b)$. $y_0 = 1$ means the binary image is the original image, and $y_0 = -1$ means the image is the stego image.

4 Experiment Results and Performance Comparison

4.1 Procedure and Result of Experiment

According to the algorithm proposed in III-B, a binary image set for experiment is first constructed. Without loss of generality, choose the most commonly used 11pt (Song typeface), 11pt(Black typeface), 12pt (Song typeface), 12pt(Black typeface), 13pt (Song typeface), 13pt(Black typeface), 14pt (Song typeface), 14pt(Black typeface), 15pt (Song typeface), 15pt(Black typeface), 16pt (Song typeface), and 16pt(Black typeface) with size of 512×512. There are 12 classes typeface with 120 image in each class and 1440 binary original images altogether which compose image set A .

1440 binary stego images are got by embedding information with maximized capacity into every image of image set A through Yang's steganography which compose image set. B_Y 1440 original binary image and 1440 steganography binary image construct experiment image set $\Psi_Y = \mathrm{A} \cup \mathrm{B}_Y$, $|\Psi_Y| = 2880$.

Embing information into every image of set A through Wu's steganography. The embedding method is to making the central pixel of the block with the highest value(0.625) in 3×3 blocks flip, and for other small value block there is no information embedded, viz. flipping COL[7](centers of L-shape patterns)pixel to realize embedding. Using this method to hide information, we can get 1440 binary stego image, which compose image set B_W .Combing the two image sets we get experiment image library $\Psi_W = \mathrm{A} \cup \mathrm{B}_W$, $|\Psi_W| = 2880$.

Then carry out the steganography analysis on image library Ψ_Y and Ψ_W .The results of the experiment is shown in table 1. Because the original image and the stego image in the constructed experiment image set is half and half, so in formula (5) $P_1 = P_2 = 0.5$, the synthesis test accuracy in talbe 1 is $P_r = 1 - \frac{\eta + \alpha}{2}$.

4.2 Experiment Results Analysis and Performance Comparison

It can be seen from the experiment results in table 1 that: when the number of the randomly chosen training image is only 12, the synthesis test accuracy of the algorithm on 2880 images in experiment image set Ψ_Y can achieve 99.51%; when the number of the randomly chosen training image is 24, the synthesis test accuracy of the algorithm on 2880 images in experiment image set Ψ_Y can achieve 100%. It first

Table 1. Experiment Results

Experiment and experiment image library	Training Number of training image	ω	b	Detection Number of detected image	Synthesis test accuracy
Experiment 1 Ψ_Y	12	[24.535,44.019, 73.259,104.06]	-2.8889	2880	99.51%
Experiment 2 Ψ_Y	24	[5.92,47.385, 92.895,160.45]	-3.3951	2880	100%
Experiment 3 Ψ_W	24	[16.962, -358.67, -0.50962, 271.66]	-0.4881	2880	95.28%
Experiment 4 Ψ_W	96	[-193.59, -709.4,323.81, 423.52]	1.2707	2880	97.64%

indicates that the algorithm has high correct detection probability on stego image based on Yang's steganography, and the probability of false alarm and miss detection is zero. Secondly, it shows that the multi-parameter judgment based on SVM effectively eliminates the false alarm and the miss detection resulting from single parameter judgment. Thirdly, the detected image is the image with mixing typeface and mixing type size, which means the algorithm has high adaptability. At last, only few training image required (the proportion of training image in experiment image is 0.8%~3%) illuminates that the algorithm has high efficiency and applicability.

It was showed by the procedure and results of the experiment that the synthesis test accuracy of the algorithm on stego image based on Wu's steganography can achieve 97.64%. When the number of the training image increases, the synthesis test accuracy increases slowly, and can't achieve 100%. The results not only prove that the proposed algorithm has high synthesis test accuracy on Wu's steganography, but also illustrate that Wu's steganography has higher cryptcity over Yang's steganography. It is easy to see in table 2 that, under the condition of mixing typeface and mixing type size, the synthesis test accuracy test accuracy of the proposed algorithm on Yang's steganography and Wu's steganography can achieve 100% and 97.64% respectively, which is the highest in the three algorithms. The classification procedure of the proposed algorithm is based on SVM, which belong to multi-parameter judgment, and the quantity of the images needed is few, so it has strong popularity and good practicality.

5 Conclusions

According to the linear separability between "the run statistical difference of the original image and the stego image" and "the run statistical difference of the original image and the secondary stego image", based on SVM and secondary steganography technology, a new information embedding detection method is proposed in this paper. This method can not only has good analysis and detection performance on the stego images based on Yang's and Wu's steganography algorithm, but also is practical and

easy to extend. Since the run statical difference may suppress the random noise, the proposed method which takes the run statical difference as the characteristic vector may be robust to the noise, which requires further research.

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Web Security Vulnerability Analysis Using Network and Information Security Tools

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Abstract. The web security vulnerabilities such as eavesdropping, impersonation, data sniffing, denial of service, and port hacking are investigated by analyzing the security weakness using the security exploration tools. Security management policies were developed based on these analyses. The results indicated that security policies produced from there analyses would enhance the web security tremendously on an organizational network.

Keywords: Information and Network Security, Web Security Vulnerability Analysis.

1 Introduction

Web security has become one of the main concerns in today's web computing [1]. While wired and wireless network infrastructures in an organization have grown over the years for web computing, their security awareness lags behind. There are many security threats that organizational network infrastructure and clients facing today in the web application. Some of them are [2] stealing information through sniffing the network packets, scanning the open ports on the machines for intrusion, sniffing and cracking passwords through ARP (Address Resolution Protocol) poisoning, and stealing vital information by cracking database passwords. In this paper, we will discuss how to explore these vulnerabilities in wireless and wired network using some of the most deadly network and information security tools available on the web and the security policies developed to manage these flaws.

Several powerful web security tools have been studied on the Bradley network to explore the security vulnerabilities. Wireshark [3] is an efficient packet sniffer available on the web and were used to capture live traffic flowing through the Bradley network and to reveal the information hidden in the packets. Cain and Abel [4-5] is a password recovery tool. We used it to recover passwords by sniffing the network and cracking encrypted passwords using Dictionary, Brute-Force, and Cryptanalysis attacks. It can be used to record VoIP conversations, to decode scrambled passwords, to reveal password boxes, to uncovering cached passwords, and to analyzing routing protocols. Nmap [6] is a port scanning tool that can be used to discover the status of computers and services on a network in an organization. This information, if used negatively, would pose an increased security threat for web applications.

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Based on the security vulnerabilities revealed, corresponding security management policies to counter the above threats were developed. The results indicated that security policies produced from there analyses would enhance the web security tremendously on an organizational network. These policies could be used as a base to develop more comprehensive computer network security management policies for the web computing.

2 Develop Security Policies to Defend the Packet Sniffer

A packet sniffer, sometimes referred to as a network monitor or network analyzer, can be used in promiscuous modes on a network that an intruder can capture and analyze the security vulnerabilities from the network traffic. Usually within an organizational network, the username and password information is generally transmitted in clear text in HTTP port 80, which means that the information would be viewable by analyzing the packets being transmitted. This will create a severe security problem in an organizational network. To explore this security weakness, we have used a well-know packet sniffer tool on the web to capture the traffic on the Bradley network.

Wireshark is an efficient packet sniffer tool that not only can capture the live traffic out of the organizational network but also reveal the information hidden in those packets. The packet sniffers can be setup to capture filtered data packets specifically for the web computing. Figure 1shows the initial look of the tool with the capture filter set to tcp port 80 to capture the web traffic. Figure 2 and 3 listed the captured web traffic and email traffic respectively, and Figure 4 showed the captured user name and password.

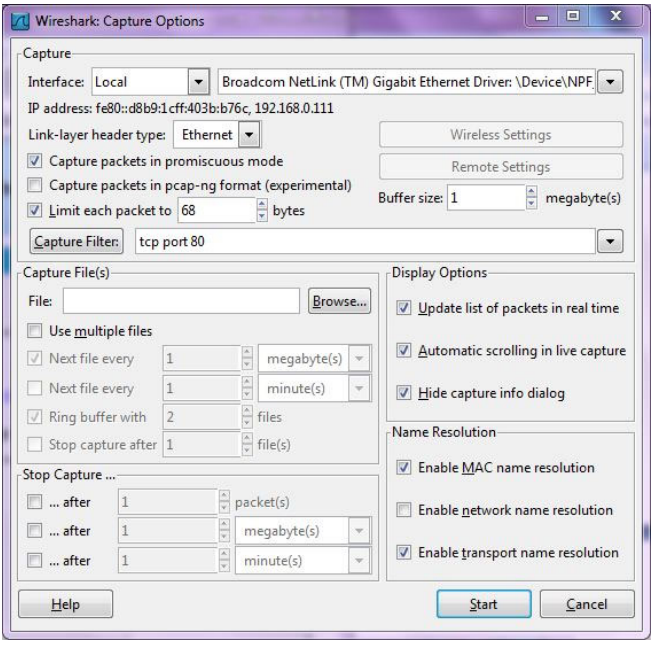

Fig. 1. Wireshark initial look with capture fillter set to Web traffic

Bradley network is in a shared Ethernet environment where all hosts are connected to the same bus and compete with one another for bandwidth. In such an environment packets meant for one machine are received by all the other machines. Thus, any machine in such an environment placed in promiscuous mode will be able to capture packets meant for other machines and can therefore listen to all the traffic on the network.

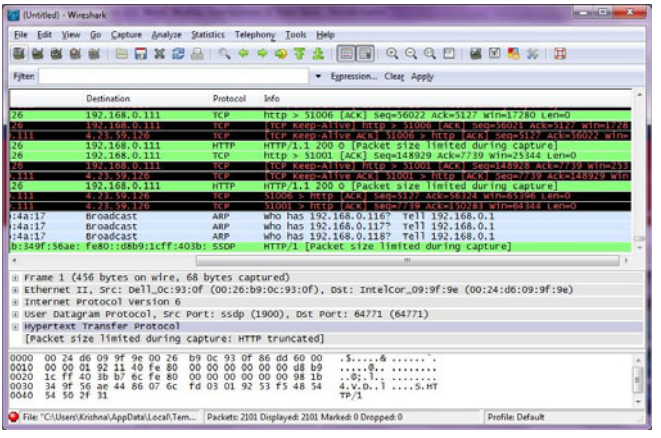

Fig. 2. Captured web traffic

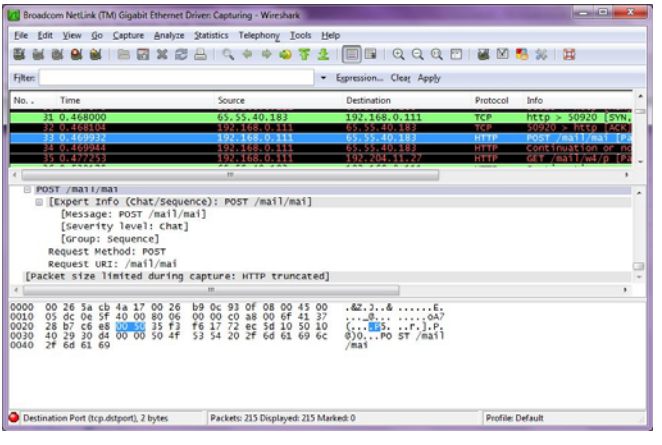

Fig. 3. Captured email traffic

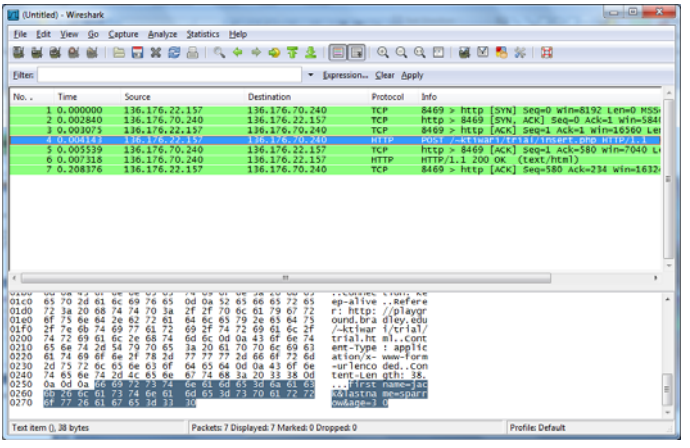
(Untitled) - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter: Expression... Clear Apply
No. Time Source Destination Protocol Info
1 0.000000 136.176.22.157 136.176.70.240 TCP 8469 > http [SYN] Seq=0 Win=8192 Len=0 MSS
2 0.002840 136.176.70.240 136.176.22.157 TCP http > 8469 [SYN, ACK] Seq=0 Ack=1 Win=584
3 0.003075 136.176.22.157 136.176.70.240 TCP 8469 > http [ACK] Seq=1 Ack=1 Win=16560 Le
4 0.004141 136.176.22.157 136.176.70.240 HTTP POST /~ktiwar1/trial/insert.cgi HTTP/1.1
5 0.005539 136.176.70.240 136.176.22.157 TCP http > 8469 [ACK] Seq=1 Ack=580 Win=7040 L
6 0.007318 136.176.70.240 136.176.22.157 HTTP HTTP/1.1 200 OK (text/html)
7 0.208376 136.176.22.157 136.176.70.240 TCP 8469 > http [ACK] Seq=580 Ack=234 Win=1632
Text item (), 38 bytes
Packets: 7 Displayed: 7 Marked: 0 Dropped: 0
Profile: Default

Fig. 4. Captured user name and password

To develop the security policies to defend the packet sniffer is not an easy task. First, it is not possible to require all web servers to run HTTPS instead of HTTP with encrypted traffic in an organization. Theoretically it's impossible to detect a packet sniffer, because they just capture the network traffic but doesn't transmit anything. Although, practically there are some methods by which we can use detect a packet sniffer on the network. The following security policies were developed for Bradley network security management.

Security policies:

1. Set up HTTPS web servers and Secure Wireless network for sensitive web applications in the organization if possible.
2. For HTTP web traffic, periodically detect the packet sniffer on the network use the following methods.

- Send an ARP (the Address Resolution Protocol) packet to the IP address but not the MAC address of the machine that is suspected of running a packet sniffer. Ideally, no machine should see this packet, as each Ethernet adaptor will reject it since it does not match its own MAC address. If the suspect machine is running a sniffer, it will respond since it does not reject packets with a different destination MAC address. The simplest ARP method transmits an ARP to a non-broadcast address. If a machine responds to such an ARP of its IP address, then it must be in promiscuous mode.
- Most programs do the automatic reverse-DNS lookups on the IP addresses they see. Therefore, a promiscuous mode can be detected by watching for the DNS traffic that it generates. We can monitor incoming inverse-DNS lookups on the DNS server in the Bradley network. Simply do a ping sweep throughout the organizational network against machines that are known not to exist. Anybody doing reverse DNS lookups on those addresses are attempting to lookup the IP addresses seen in ARP packets, which only sniffing programs do.

- Use the SNMP management tool on the smart hubs to automate the monitoring of Ethernet hubs in the Bradley network. The management consoles will log connections/disconnections to all the organizational network ports. We can configure the system with the information where all the cables terminate to track down where a packet sniffer might be hiding.

3 Develop Security Policies to Defend the APR Poisoning

Computer connected to a network has Ethernet MAC address and Internet IP address. ARP is used to find the MAC address of the destination machine, given a destination IP. Cain and Abel (figure 5) web tool then can be used by the network hackers to break the network and steal the valuable information, especially by using ARP poisoning. As ARP is a stateless protocol, most operating systems will update their cache if a reply is received, regardless of whether they have sent out an actual request. ARP spoofing involves constructing forged ARP replies. By sending forged ARP replies, a target computer could be convinced to send frames destined for one computer to instead go to another computer. When done carefully, the intended computer will have no idea that this redirection took place. This process of updating a target computer's ARP cache with a forged entry is referred to as "ARP poisoning". With attacker poisons the ARP cache of machines, then it can set up a Man in the Middle attach by associate these machines' IP address with attacker's MAC address. This is extremely potent when we consider that not only can computers be poisoned, but routers/gateways as well. All Internet traffic for a host could be intercepted with this method by performing this attack on a target computer and the LAN's router. Sniffing using Cain and Abel web tool can then be performed on the attacker's machine.

To defense against ARP spoofing, MAC binding can be used to prevent changes to the MAC tables of a switch in a relative small organizational network such as Bradley network or networks without using DHCP (Dynamic Host Configuration Protocol). For large network, tools can be used to detect and block all ARP poisoning and spoofing attacks with a static ARP inspection and dynamic ARP inspection approach on LANs. For example, the DHCP service on the network device keeps a record of the MAC addresses that are connected to each port, so it can readily detect if a spoofed ARP has been received. The following security policies are developed to defend such attacks.

Security Policies:

1. Set up web tools to detect the ARP spoofing by performing ARP packet inspection on a per-network-interface basis with configurable inspection filters and sending a notification whenever an ARP entry changes.
2. Set up web tools to clean up the poisoned dynamic entries by actively verifying the ARP entries in the client and default gateway cache, and delete the spoofed entries.

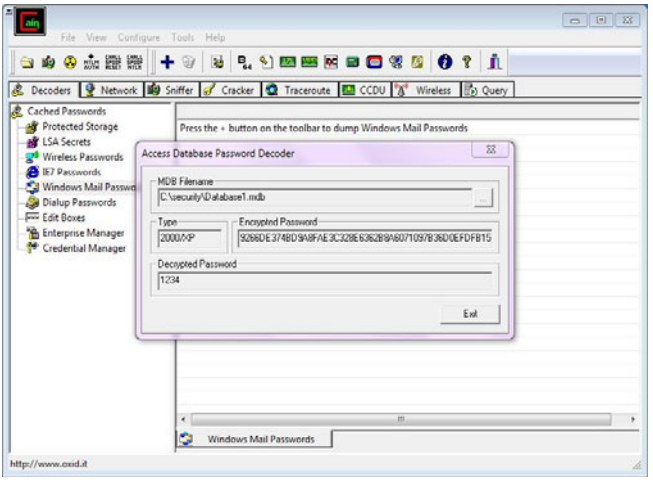

Fig. 5. Cain and Abel Web tool is used to recover the password

4 Develop Security Policies to Defend the Port Scanning

Port scanners are the programs to determine that how many ports are open on a computer. Nmap, is a port scanning tool that can be used to discover status of computers and services on a computer network. Nmap is also used for network exploration or security auditing. It uses raw IP packets to determine what hosts are available on the network, what services those hosts are offering, what operating systems they are running, and what type of packet filters/firewalls are in use. Figure 6 shows the Nmap GUI with scan output on www.google.com. The Google server is well protected without reveal any security weakness (997 filtered ports can't be scanned).

Security Policies:

1. Set up web tools such as Nmap to performing port scan periodically on the server computers on Bradley network. The list of opened ports, the time duration that the port has been opened, and the associate programs that opened the port will be sent to a network database.
2. Set up a monitor program that checks the opened ports and their associated programs on the machines with a target list. The target list listed allowable operations on the servers (target list will be updated periodically.) Any suspicious items will be automatically send to the system administers for further inspection.
3. Set up a clear up program that will close all the ports on the server specified by the system administers.

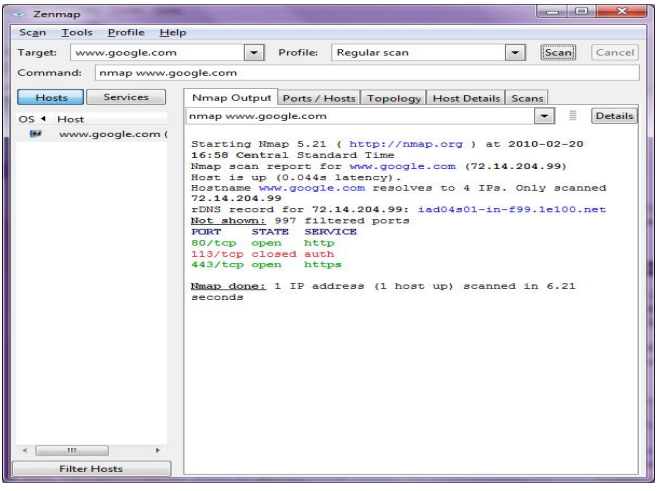

Fig. 6. Nmap scan output with the target machine set as www.google.com

5 Conclusion

Web applications implemented on an organizational network have many security issues. We have investigated and selected a set of powerful and useful web tools to reveal the security vulnerabilities on these applications. The information gathered from these tools illustrated that, if used improperly and harmfully, it can pose great threats to an organizational network security. We have developed corresponding network security management policies and programs to counter these threats. These policies and programs can be used as an initial stage to launch a much more sophisticated organizational network security management for all web applications.

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Co-word Analysis for the Competitive Intelligence of Automotive Industry in China

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Abstract. Web co-word analysis is a way to measure the closeness among organizations suggested by Liwen Vaughan in 2010. In this study, we chose to apply this method to the competitive analysis of Chinese automotive companies in the auto market of China. The list of forty-four automotive companies studied in this paper was obtained from the report of Global Top 50 automotive productions in OICA. The study shows that although Chinese manufacturers have made great progress on the production, the technology of China's domestic automotive industry is still far behind the world class, Chinese automotive companies compete with each other in middle & low-end car market due to their less advanced technology in manufacture process, nowadays the middle & high-end car market is still firmly occupied by foreign brands from developed countries. And China's domestic brands perform very well in the market of LCV, HCV and heavy bus. And among all the Chinese automotive companies, BYD auto and Chery are most competitive in the middle & low-end market.

Keywords: Webometrics, web co-word analysis, Competitive intelligence, automotive industry, market analysis.

1 Introduction

Webometrics from 1977 has made great progress until now[1], and mainly focus on the study of web hyperlinks, including inlinks, outlinks, co-links[2]. However, the gradually narrowed access to the tools of collecting web hyperlinks data has been a bottleneck to the further development of Webometrics. MSN has stopped the hyperlink search service in 2007, AltaVista and All The Web have been purchased by Yahoo in 2003, nowadays the commercial search engines remained for web hyperlinks collecting are Yahoo and Google, however they don't support the search for web co-links. The study of relationship among organizations based on co-inlink analysis is infeasible unless the researchers develop tools to get co-link data from the search results returned by these commercial engines.

Liwen Vaughan in 2010 suggests that web co-word analysis can be used to measure the closeness between two organizations[3]. Web co-word analysis assumes that the bigger the number of times of two organization's names simultaneously occurred on webpages, the more related these two organizations would be. If the organizations are all businesses, the more related the two companies are, the more likely they are business competitors.

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In this study, we chose to study the competitive landscape of Chinese automotive manufacturers in Chinese automotive market based on the fact that related businesses are competitors. The web word co-occurrence matrix of the automotive companies' Chinese short names was obtained with Google Blog search engine; here Chinese was served as a way to specify the search zone as China in Google Blog. After the matrix was normalized with Jaccard Index, a tree map showed the relationship among these companies can be obtain with SPSS, and we can get the competitive landscape of Chinese automotive market based on that tree map.

2 Methodology

2.1 Business Sectors Studied

All fifty companies were got from a reputable statistical report named Global Top 50 Car Manufacturers Output Volume in 2009 at oica.net[4]. These companies are major automobile manufacturers worldwide. As we focus on the study of the automobile market in China, six companies including OAO AvtoVAZ, Mahindra, Kuozui Motors, GAZ Group, Navistar International Corporation, Ashok Leyland, which don't sell cars in Chinese mainland were excluded from the our study. As a result, totally 44 companies were remained in the study. We obtained the Chinese short name of these companies from their Chinese official websites. The Chinese short names were necessary because we studied on Chinese automotive market, and the names of these companies were served as queries in Google Blog search engine.

2.2 Web Co-word Data Collection

Liwen Vaughan in her pervious study suggests that Google Blog is a better data source than Google in co-occurrences data collection, blogs are usually wrote by people who know well about the industry, therefore there is deeper analysis in blogs than in the general Web. Thus in this study we chose Google Blog as the data collecting tool[3].

Since we chose to study the Chinese automobile market, we use Chinese as the query language. We used every two companies' Chinese short names as a query, and specified the search range to all the Chinese blogs. For example, to search for co-occurrence of company Toyota Motor Corporation and company BMW AG, we used the query "丰田 宝马 汽车", in order to make sure the search results contain the content about automobile, we add Chinese word "汽车" to the query, "汽车" stands for automobile in English, there was no Boolean AND operator in between the search terms as it is the default search. All the web co-word data on webpages in this study was collected in Dec.12, 2010.

3 Data Analysis

3.1 Normalize the Matrix with Jaccard Index

By using every two companies' Chinese names as a query, we can get a 44*44 web co-word matrix data from Google Blog. Although this original matrix can be input to

SPSS directly to do cluster analysis, the elements in this matrix were incomparable in measuring the closeness of each two companies. For example, X and Y stands for the names of two companies, assume that the number of times X and Y appear together in the search result is 8, the relationship between Company x and y would be very close if each number of times X and Y appear in the search result was 10, however their relationship would be very weak if each number of times X and Y appear was 10000. Thus this web co-word matrix needed to be normalized with Jaccard Index to obtain a relative measure of the closeness of each two companies[5].

normalized value = $n(A \cap B)/n(A \cup B)$

A is the set of web pages which contain company name X in Google Blog search result, B is the set of web pages which contain company name Y in the search result.

For example, assume the number of times the name of company X appeared in Google Blog search result is 1000, the number of times the name of company Y appear is 200, the number of times both company X and Y appear is 50, then after normalization the frequency of both company X and company Y appear is 50/(1000+200-50).

3.2 Hierarchical Cluster Procedures in SPSS

Our study is an exploratory one which can not determine the number of final clusters or the initial classification center at the beginning of the cluster analysis, thus the stepwise cluster procedures is not suitable in this study. We chose to apply Hierarchical cluster procedures to cluster the normalized matrix, and use Between Group Linkage to gradually cluster the samples, use Squared Euclidean distance to measure the distance between variables[6].

3.3 Results

The tree graph generated from the web co-word matrix is shown in Fig.1.

- Group 1 in Fig.1 comprises fifteen world-famous automobile manufacturers, which come from America, Japan, South Korea, France, Germany and Italy, sell middle & high-end cars in China auto market. The competition among these fifteen companies is much more intensive than their competition with other companies because they compete for the market share of high & middle-end car in China. As we can see from Group 1, none of these fifteen companies come from China, although twenty-one Chinese automobile manufacturers jumped in the rank of Goble top 50 auto production in 2009, Chinese automotive companies still can not have a place in the group of leading global automobile manufacturers, which means the technology of Chinese automotive industry is still far behind the world class.

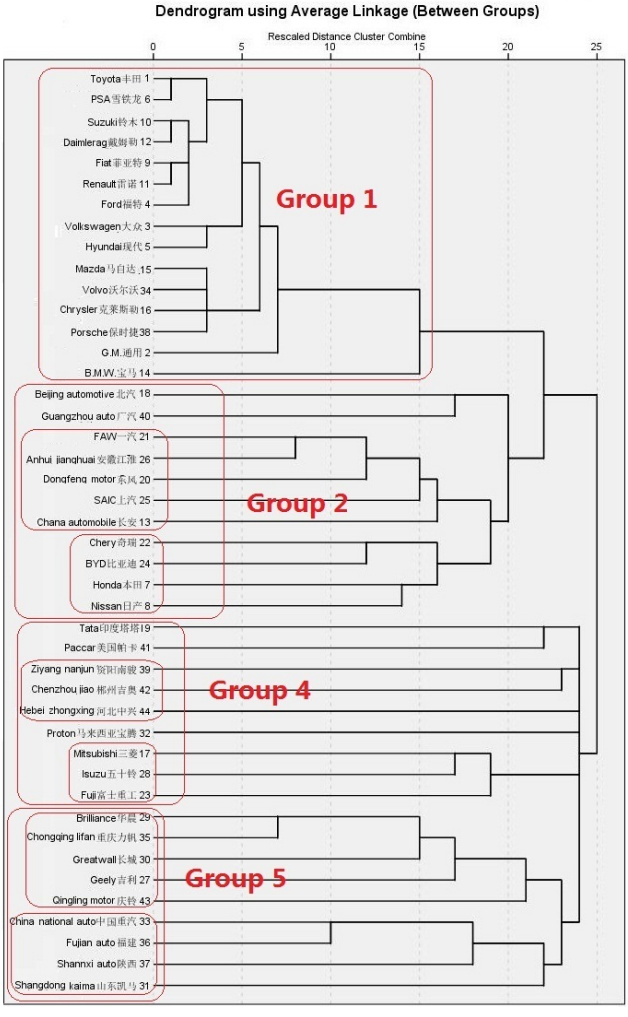

Fig. 1. Tree graph of web co-word matrix

- In Group 2 in Fig.1 there are totally eleven companies, including ten Chinese auto manufacturers and two Japanese auto manufacturers named Honda and Nissan. The competition among FAW, Dongfeng Motor, SAIC, Chana Automobile and Anhui Jianghuai Automobile is more intensive than their competition with other companies because these five companies are Chinese leading companies in the market of LCV, HCV and heavy bus. Other foreign companies compete in this market are Tata, Paccar, three Japanese companies named Mitsubishi, Isuzu and Fuji in Group 4, and other Chinese companies compete in this market are Ziyang nanjun, Chenzhou Ji'ao and Hebei ZXAUTO in Group 4, China national auto, Fujian auto, Shannxi auto and Shangdong kaima in Group 5. These companies are located very closely in

their own group, and located relatively far away in different group, and China's domestic companies are located more closely with each other and far away from foreign companies.

- From the tree map we can get the conclusion that Chinese market of HCV and heavy bus is mainly occupied by Chinese companies, and the competition among Chinese automotive companies is much more intensive than the competition with the foreign companies. This conclusion can be explained by the fact that the foreign products possess more advanced technology and better quality than Chinese automotive products, and the high price of these foreign products greatly impede their sales of HCV and heavy bus in China, and Chinese companies win the major market share because of their relatively good performance-to-price in ration when compared with foreign brands.
- It can also be found in Group 2 that the competition among Chery, BYD Auto, Honda and Nissan is very fierce, Honda and Nissan mainly sell middle-end cars in China, Chery and BYD Auto compete with them, we can get the conclusion that the technology of Chery and BYD Auto has advanced rapidly these years, their products are more competitive than other Chinese self-owned brands in the medium & low-end car market.

4 Conclusions

This study analysis the competitive landscape of Chinese automotive companies in Chinese auto market based on web co-word analysis. We found that until now although twenty-one Chinese automobile manufacturers jumped in the rank of Goble top 50 auto productions in 2009, none of Chinese automotive companies has a place in the group of world leading automotive manufacturers, they compete with each other in middle & low-end car market due to their less advanced technology in manufacture process. The middle & high-end car market with advanced technology is mainly occupied by foreign automotive companies from developed countries. And in the market of LCV, HCV and heavy bus, Chinese automotive companies gain the major market share because of their relatively good performance-to-price in ration when compared with foreign brands.

Although Chinese automotive industry still has greater disparity with the world standard, some China's domestic enterprises like BYD auto and Chery have made great progress on their automobile manufacture.

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Design Wave – A Discussion on Environmental Impact Assessment Factor

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Abstract. Based on the long-term distribution of statistic characteristics of waves and the short-term probability properties of sea state defined by giving the return period, the calculation of the return period, the height, the period, and the oceanic wave parameters of the design wave and the forecasting methods are discussed in this paper. To provide references for the operation reliability of floating structures in the extreme sea state, the method of determining the design wave parameters is resurveyed. A proposal is recommended that the design wave, which can be either significant wave with 500-year of the return period, or the maximum wave with 1/N of exceeding probability, 100-year of the return period, can be applied in the engineering design practice.

Keywords: Water waves, probability density function, energy spectral density function; reliability.

1 Introduction

It is well known that wave motion is a random process. The statistical characteristics of wave parameters are different in the probability functions both in the short-term and in the long-term. At present, there are two approaches for analyzing the data in wave observation, namely, the design wave method and the spectral analysis method. The so-called design wave is the maximum significant wave in the given return period[1-2]. The design standard for the return period of significant wave stipulated in the DNV Code was 100-year[3]. Generally, the probability density function of wave height for the short-term sample is fitted by Reighly distribution and the probability density function of the statistical characteristics in the short-term is fitted by Weibull distribution. Based on the linearized Weibull function, the wave height of the design wave can be determined when the return period is given, and the corresponding wave periods with different statistical significations can also be determined by analog approach[2]. In the extreme sea state with the return period of 100-year, the occurring probability for significant wave height is a small probability event, equaling about 10^{-9}; the probability of exceeding this significant wave height is about 14%; and the probability for floating structure encountering this significant wave height is 18% for the 20-year design life. All of the above data is the so-called probability state of the design wave. Apparently, the floating structure designed based on the design wave will still face larger risk in the operation state. It should be indicated that the ocean

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environmental data are determined on the basis of the ocean engineering practice. In view of the perils occurred at the North Sea in the 1980s, the computational methods for wave loads on the floating structures were changed in succession, from linear wave theory to 5-order wave theory and then to 8-order wave theory, in the light of DNV Code. Specially, after the perils of the sea occurred at the Gulf of Mexico in 2005 due to the hurricane Katrina, the ocean environmental condition for the design of floating structures with the standard of 100-year return period was oppugned. Whether longer return period was needed instead of 100-year? Whether the wave height with shorter exceeding probability was needed instead of the significant wave? Whether the encountering probability for floating structures could be further decreased to less than 18%? Although the risk can not be completely avoided in the ocean engineering operation, reducing risk to the fullest extent is always highly regarded by designers, builders, and operators.

2 Definition of the Design Wave

Based on the recorded observation data of the sea level elevations, the significant wave height H_S and up-zero period T_Z can be determined in the target sea area. These are the statistical characteristics for a short-term sea state and they can be accumulated into a sample in the long-term as follows:

$$\left[\left(H_S;T_Z\right)_i\right], \quad i=1,2,\cdots,N \quad \left(N\to\infty\right) \tag{1}$$

The so-called design wave is a statistical characteristic of the extreme sea state, which can be ascertained with given probability, using the sample as listed in Eq.(1). Generally, the probability density function of significant wave height can be fitted by the three-parameter Weibull function[3-5]. Then the accumulative probability function can be written as follows:

$$P\left(H_S\right)=\int_{H_0}^{H} p\left(H_S\right)\mathrm{d}H_S=1-\exp\left[-\left(\frac{H_S-H_0}{H_C-H_0}\right)^{\xi}\right] \tag{2}$$

where the parameters H_0, H_C, ξ are respectively the minimum threshold level(m), the scale factor(m), and the shape governing factor. According to the linearization processing of Eq.(2) and the data base provided by Eq.(1), the parameters H_0, H_C, ξ can be ascertained for the target sea area by the optimization arithmetic method, which has given target function of the minimum fitting standard deviation, and the iterative arithmetic method for the minimum threshold level H_0 ($H_0 \geq 0$).

The mean wave period for the short-term sea state, together with corresponding significant wave height, can form a single wave, which is stochastic in the long-term sample of significant wave height. Therefore, the wave period of significant wave height depends on the combined probability of significant wave height and its period.

For the analysis of short-term sample of waves, the mean value of 5 up-zero periods T_Z round the maximum wave is defined as the mean period T_M for this sample[3], i.e.

$$T_M = \alpha T_Z \tag{3}$$

where $1.15 < \alpha < 1.54$. The 2-parameter Weibull distribution function based on the sample of significant wave height H_S and mean up-zero period T_Z for the North Atlantic Ocean is established:

$$P\left(T_Z\big|_{H_S}\right) = 1 - \exp\left[-\left(\frac{T_Z}{\alpha}\right)^{\gamma}\right] \tag{4}$$

where $\alpha = 6.05\exp\left(0.07H_S\right)$, $\gamma = 2.36\exp(0.21H_S)$.

One of the design methods in the engineering practice of floating structures is the design wave method. The so-called design wave is the maximum wave in the defined return period T_R; it equals to 100 years according to DNV criterion. Based on the mean wave period $\overline{T}$, the occurring amount of waves N in the return period T_R can be calculated. In fact, the maximum wave is measured by the significant wave height H_S and it is defined as the design wave height H_D, with corresponding exceeding probability listed as follows:

$$1 - P\left(H_D\right) = \exp\left[-\left(\frac{H_D - H_0}{H_C - H_0}\right)^{\xi}\right] = 3.17\times10^{-8}\frac{\overline{T}}{T_R} \tag{5}$$

Now wave height H_D for the design wave can be solved from the above equation, i.e.

$$H_D = \left(H_C - H_0\right)\left[17.27 + \ln T_R - \ln\overline{T}\right]^{\frac{1}{\xi}} + H_0 \tag{6}$$

Thus, the design wave height H_D and corresponding wave period T_Z can be used to construct a single wave, which is called the design wave.

In Europe, based on a decade's wave observation data (1966-1976) in the North Sea, the design wave parameters were given[2], in which the design wave height could be calculated:

$$H_D = 2.07\left[2.3\left(\lg T_R - \log T_Z + 7.5\right)\right]^{0.91} \tag{7}$$

For T_R =100 year, $H_D \approx$32m, this is the so-called 100-year wave height, which is just the defined value given by DNV. It can be derived from Eq.(7) that the wave period for the 100-year wave height equals 6.3s. However, it should be further discussed as follows.

1) According to Eq.(7), when the wave period is in the range of T_Z = 6~32s, the 100-year wave height H_D is changed with an amplitude of 2.4m only, and declined with increasing of the wave period, see Fig.1.

2) It is well known that the wave steepness is limited due to gravity. Generally, $H/L=1/7$ (L is the wavelength). In deep water $L=gT^2/2\pi$, the limited wave period will be 12s when the wave height is 32m.

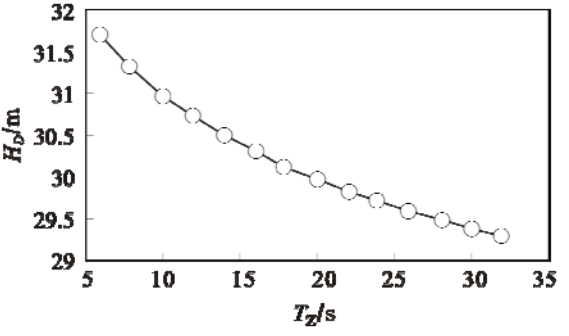

Fig. 1. Relation between the design wave height and corresponding wave period

3) For the statistical characteristics of extreme sea state, the significant wave height is corresponding to an up-zero period, which has larger probability, and usually, such wave period can be determined by Wiegel formal[1].

$$T_Z\big|_{H_S}=15.6\left(\frac{H_S}{g}\right)^{\frac{1}{2}} \tag{8}$$

For the design wave of 32m high, the limited wave period should be 28s, as shown in Fig.2.

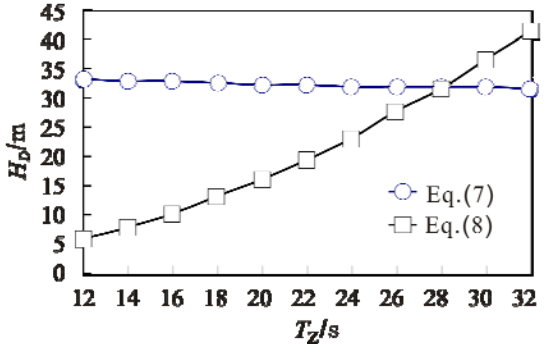

Fig. 2. Determination of the wave height and up-zero period for the design wave

It can be seen that for a design wave of 32m high, the corresponding wave periods are stochastic values also. When T_Z =12s, the wave steep H/L =0.1429 for a significant wave of 32m high, which means a higher nonlinear wave. When T_Z =28s,

the wave steep H/L =0.0261 for a 32m significant wave with higher probability. This can be almost regarded as a linear wave. Thus from the engineering point of view, as for the small probability events in the sea with significant waves of 32m high, the sea state with 32m waves and 12s wave period is more dangerous and should be paid with more attention.

3 Return Period of the Design Wave

The definitions on the return period for extreme events are different in different engineering fields and subjects. It depends on occupancy of historical observation data, grade of risk, level of existing analysis and prediction technologies, and actual experience in engineering practice.

In the ocean engineering field, the return period of extreme sea state originated from the initial period of developing the petroleum resources in the North Sea (1960s~1970s), and then it was defined by DNV Code. The design wave height for floating structures is the maximum wave occurred once in a hundred years in the operating sea area. As to the application of return period, there're some points for the attention[6].

1) The computation of the design wave height as listed in Eq.(7) is established based on a basic assumption that the probability density function of long-term distribution of significant wave height, which is the statistical characteristic of short-term sea state, is fitted by Weibull probability function.

2) The calculation of significant wave height for statistical characteristics is based on the short-term samples, which come from the observation records in more than 10 years in the target sea area. In this data base, the average occurring probability for each sea state is about 10^{-7}, and the average occurring probability for 100-year wave height is about 10^{-9}, which was obtained by extrapolation with the 2-order magnitude.

3) For the ocean structure with T_L years of the service life, the encountered probability can be calculated under the assumption of independence between the waves less than the design wave height and that equalling:

$$P_E = 1 - \exp\left(\frac{T_L}{T_R}\right) \tag{9}$$

Obviously, as to the oceanic structure with 20 years of the service life, the probability of encountering extreme 100-year wave height ($\sim 10^{-9}$) can be up to 18%.

4) In the days after hurricane Katrina surprisedly attacked the Gulf of Mexico, people became puzzling: whether the design standard for 100-year wave was reasonable, whether the design code for oceanic structures was feasible. The crux is the determination of return period. By Eq.(7), when the return period was extrapolated up to 500-year, it can be seen that comparing with the 100-year return period, the design wave height is increased from 32 m to 34 m, as shown in Fig.3.

5) Similarly, by Eq.(9), when the return period was extrapolated to 500-year, the encountering probability of structure with 20 years of the service life was decreased to 4%, fell 14% points, see Fig.4. That means the risk of oceanic structures in waves will be reduced remarkably.

It should be pointed out that the above analysis is based on the wave observation data of 10 years' records. In fact, if the return period is extended to 500-year, the observation term of waves, the capacity of sample, the fitting probability density function, the manner of extrapolation, and the arithmetic of every probability characteristics should be reconsidered. Although the risk can be decreased in above analysis, higher investment is undoubted for the design, construction, operation, and maintenance. The balance of gain and loss for determination of the return period is important to the design.

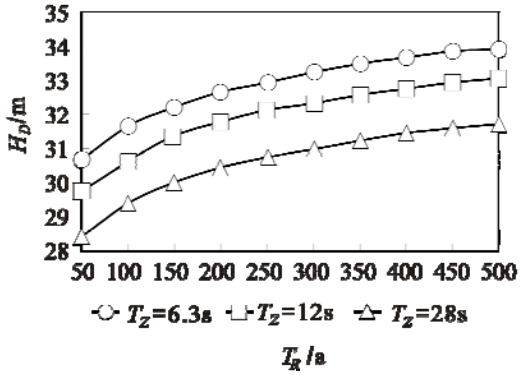

Fig. 3. Relation between the design wave and the return period

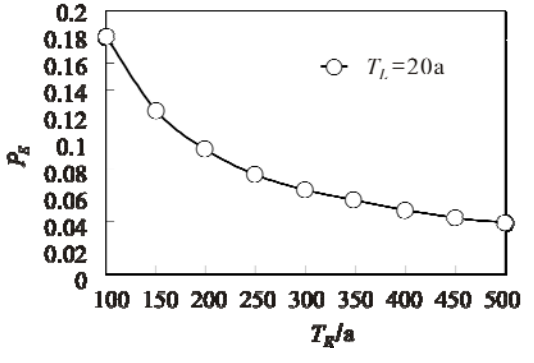

Fig. 4. Relation between the return period and the encountering probability

4 Sea State of the Design Wave

The design wave is a single wave in random waves, and is defined by significant wave height and corresponding wave period. In fact, the probability exceeding significant wave height can be up to 14%. Approximatively, the lower limit value of wave height with $1/N$ of exceeding probability can be given as follows:

$$H_{1/N} = H_S \sqrt{\frac{1}{2} \ln N} \tag{10}$$

From Fig.5, it can be found that the lower limit value of the maximum wave height with 1/10 of exceeding probability, $H_{1/10} \approx 34$ m, which is equivalent to the wave height with 500 years of the return period.

Based on the design wave height and appropriate selection of wave energy's spectral density function, obtain the frequency response function of performance for the target structure by numerical or physical simulation, and derive the response spectrum of such performance from the transform in frequency domain, and finally all kinds of data needed in the design can be ascertained by characteristic analysis of responding spectrum. In order to complete the above computation and analysis, there are still some problems to be further discussed.

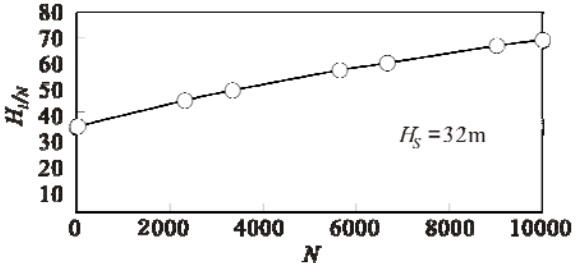

Fig. 5. Distribution of wave heights when the wave height of the design wave exceeds significant wave

1) On the transform system in frequency domain. In frequency domain, the following linear transform system is still used up to now:

$$S_Y(\omega) = |H(\omega)|^2 S_X(\omega) \tag{11}$$

where $S_X(\omega)$ is the input energy's spectral density function, $H(\omega)$ and $S_Y(\omega)$ are the frequency response function and the output energy's spectral density function respectively. As the extreme waves are remarkably nonlinear and the response is nonlinear also for structures, the use of Eq.(11) is limited in the engineering computation. The first approach is direct computation, in which the response process is calculated in the time domain and then the statistical characteristics can be determined according to the response time history. The second one is approximative computation, in which the response function is determined by nonlinear CFD only and the transform system in frequency domain still keeps the relation given by Eq.(11).

2) On the return period and the exceeding probability for the design wave sea state. Increasing the return period will induce rising of the design wave height and declining of the encountering probability. On the other hand, to maintain the return period occurred once in a hundred years, the maximum wave height with 10% of the exceeding probability can also reduce the encountering probability.

5 Conclusion Remarks

Design wave is the base of the environment data for oceanic structure design and the rationality of determining design wave parameters will be affect on the economics, security, and reliability of the oceanic structure design, construction, and operation. The following conclusion remarks are given from this discussion:

1) When the return period of the design wave is increased from 100-year to 500–year, the significant wave height of extreme sea state is also increased from 32m to 34m, with an increment of 2 m (about 6%); the encountering probability is decreased from 18% to 4%, falling 14% for oceanic structures with 20 years of the design service life. It can be convinced that applying 500-year of the return period can observably decrease the design risk.

2) The integration of the design wave method and the spectral analysis method will be the best computational approach. The design wave height is a statistical characteristic of extreme sea state, i.e. significant wave height. In this sea state, the spectral analysis method can be used to determine the hydrodynamic and structural performance of oceanic structures. The statistical characteristic is increased to the maximum value of 1/10 exceeding probability (the increment of wave height is about 2 m also) and the probability of encountered can be decreased to 10%.

3) In order to determine the period of the design wave, the investigation on the joint probability of wave height and wave period is necessary. Both nonlinear steep waves and long waves need to be attended in the design.

Finally, the following suggestions are listed as general discussion topics. If the 100-year of the return period is used continually the maximum wave height with 1/10 exceeding probability and corresponding up-zero period should be the design wave parameters instead of the signification wave in the sea state occurred once in a hundred years. To reconsider and to research the new design concept with the 500-year return period are recommended also.

Of course the design standard for environmental condition is a complicated problem, therefore, further research is important and urgent. Besides the weighting analysis is necessary both for engineering expenses and for operative risk.

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An Congestion Avoidance and Alleviation Routing Protocol in Sensor Networks

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Abstract. Congestion in wireless sensor networks (WSNs) not only affects transmission reliability, and will waste valuable energy resources. In order to reduce the wireless sensor networks routing instability, a congestion avoidance and alleviation (CAA) routing protocol. In this work, we address the problem of congestion in the sensor networks. Our primary objective in using this approach is to adaptively detect the potential congestion timely and effective; make data packet arrival rate in the nodes equal to packet service rate, so that the occurrence of congestion in the nodes is seamlessly avoided. Once congestion happens inevitably, CAA is presented to reallocate traffic with altering route protocol to mitigate congestion, avoid conflict, enhances data transmission reliability of CH; Congestion data local preservation strategies, it effectively avoid data lost during the congestion period and guarantee the reliability of data transmission . The results shows have shown that the proposed algorithm is capable of successfully avoiding congestion requiring reliable networks.

Keywords: Wireless sensor network, congestion avoid, congestion alleviation, cluster header, multipath seletion.

1 Introduction

Wireless sensor networks have a wide range of applications in surveillance, precision agriculture, structural damage assessment, and military target tracking. [1]. As the energy of the wireless sensor network nodes is limited, the general level of cluster-based routing, many routing protocols are based on this principle design. However, most only consider the energy conservation, few consideration bunch of congestion, when the data flow over buffer memory of the cluster header(CH) will trigger congestion. Congestion will lead to packet loss rate increase, affecting transmission reliability, but also reduce the throughput, lead to the waste of valuable energy resources, result in serious network paralyzed.

To support these emerging applications, we studies three techniques and shows that the adverse affects of network congestion can be greatly alleviated when they operate in concert. The first technique is cross layer cognition detection technology to detect the potential congestion timely and effective; the parent CH congestion exceeds a predefined congestion threshold, the first node whose congestion degree exceeds the hotspot proximity threshold will become the initiator and start creating altering routing. The second technique is altering routing protocol to mitigate congestion,

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avoid conflict, enhances data transmission reliability of cluster header; The third technique is Local data storage .In each cluster, each CH appoint a buffer node to act as data buffers during congestion periods in order to avoid buffer drops. In isolation, each technique helps somewhat, but when acting in concert, it dramatically improves network efficiency, fairness, and channel loss rates. These experimental findings, together with the design details of the aforementioned mechanisms, are the primary contributions of this paper.

2 Relation Work

The growing interest in WSNs and the continual emergence of new techniques has inspired some efforts to congestion avoid and alleviation routing protocols in this area. Experiments [2] showed that maintaining an operating point that does not exceed the capacity of a sensor network is critical to improving performance in both networking and application metrics. However congestion control in sensor networks had not received serious study until recently. Most current control mechanisms are rate based. In [3], they propose a reliable transport technique called event-to-sink reliable transport (ESRT) protocol. In ESRT, the sink periodically configures the source sending rates to avoid congestion, points out that the rate of data packets sent to meet certain needs of reliability, but the literature did not give any congestion control mechanisms. In CODA [4], they present a detailed study on congestion avoidance in sensor networks. The basic idea is that as soon as congestion occurs, the source (or an intermediate node)'s sending rates must be reduced to quickly release the congestion. In the simple case, as soon as a node detects congestion, it broadcasts a backpressure message upstream. An upstream node that receives the backpressure can decide to drop packets, preventing its queue from building up and thus controlling congestion. If multiple sources are sending packets to a sink, CODA also provides a method of asserting congestion control over these multiple sources by requiring constant feedback (ACKs) from the sinks. If a source does not receive the ACKs at predefined times, it will start throttling the sending rates.

In recent years, sensors in the congestion problem have aroused the concern of the academes. Most studies on congestion avoid and control in sensor networks in the literature deals with traffic control less literatures are based on guaranteed data reliability during congestion control. In the following sections we will present our protocol that ensures data persistence under congestion control in WSNs. The remainder of this paper is organized as follows: Section 3 defines CAA network model. Section 4 presents CAA in detail. Section 5 provides some initial simulation results. Finally, section 6 concludes the paper.

3 Network Model

Suppose sensor nodes are randomly distributed in the area and remain stationary after deployment. Nodes will sense their environment and report readings to a sink in constant time intervals t. We consider the following properties about the network:

1) Nodes are grouped into small clusters and each cluster has a cluster head;

2) The cluster head is responsible for data gathering from the cluster members;

3)The head node will also perform the duty of a routing node by forwarding collected data towards the sink;

4)Cluster heads manage members of the clusters in the clusters by assigning them awake or sleep status depending on the node density;

5)Data collected by the sensor nodes is of diverse nature;

6)Nodes will fail only when they run out of energy.

4 Proposed Protocol

4.1 Cluster Header Selection

In CAA, each node keeps a neighbor information table, which includes neighbor node's relevant information. Similar to the literature [8], each node S_i has unique identifiers ID_i in the network. In each round, each node gets all its neighbors of residual energy. Where E defines as the node initialization of energy, $E^i_{resiual}$ representing the residual energy of the neighbor node S_i within the radius r of the maximum number of nodes, competitive cluster-heads parameter T can be given as:

$$T = (E^i_{resiual} \times V^i_{residual} \times D_i)/(E \times V) \tag{1}$$

In the first step, each node broadcasts candidate message, which contains node message and competitive cluster-heads parameters. in the message is sent to his neighbors to the same time, each node to node all the neighbors the records and to a neighbor in the table. The neighbor candidate nodes received the candidate messages, records the ID and T in the table. In CRRA, if S_i get the maximal competition cluster-heads T at time slice t, S_i broadcasts "win cluster head" message to his neighbors. Through the above steps, the cluster header has been elected. Ideally, a node has a higher priority than its neighbors, if it is closer to the event spot and has more residual energy.

Step 2, S_i broadcasts "win cluster head" message for announcing itself to be a representative node. Other information received from cluster-heads node cluster-heads node, the information as candidate nodes to multiple cluster-heads, candidate cluster-heads node respectively message sent JOIN. Cluster-heads node will create cluster member list, and in general, after receiving the message node list of members to join node. Fourth step, selection of cluster-heads cluster member of the highest parameters as cluster-heads backup. When cluster-heads node collided, will transmit data backup cluster-heads temporary.

Step 3, cluster nodes send cluster-heads backup information for updating the cluster nodes information table, including cluster-heads ID and backup cluster-heads ID.

Step 4, cluster-heads choice clusters of the communication between the CDMA code and the members of the cluster TDMA time slot.

4.2 Path Tree Creation

At each round the network establishes a new routing topology by setting up new cluster head alternate routing paths. To set up alternate routing paths, the base station initiates a route setup phase by advertising a route update (with its hop count = 0) to be flooded through the network. Then, each receiving CH records the CH sending the route update with the lowest hop count. As the first parent CH, stores its hop count, and re-broadcasts it with the hop count plus one. If the hop count of the received route update is equal to the first parent node, each node records the node sending the route update as a candidate parent node. Otherwise, no action has to be taken.

When the route setup is completed, each node has the first parent node and, if ever, multiple normal parent nodes. Each node treats the first parent node and all of the normal parent nodes equally as next-hop nodes. When the node has messages to be forwarded, it forwards each message to one of the next-hop nodes with less congestion level.

By setting up new cluster head alternate routing topology, the source traffic can be suppressed to avoid potential congestion without degrading the fidelity achieved at the sink. Meanwhile, the traffic reduction decreases not only interference, contention and collision in the wireless medium, but also energy consumption for data packet transmission. However, it is only a proactive method for congestion avoidance. Multiple simultaneous traffic flows originated from different event areas might occasionally induce congestion due to gradually traffic merging on the routing paths. More work should be done for congestion detection and alleviation.

5 Congestion Detection

Congestion detection plays a vital role in congestion control. Congestion detection mechanism requires not only accurate, and low cost. Therefore, we must define congestion degree, making nodes can be quickly and efficiently detect congestion and the adoption of appropriate measures to alleviate congestion.

Definition 1. Packet inter-arrival time packet T_a. Inter-arrival time is defined as the time interval between two sequential arriving packets.

Definition 2. Packet service times T_s. The time interval between when a packet arrives at the MAC layer and when its last bit is successfully transmitted.

Escape of dithering, T_a and T_s at each node are measured using EWMA algorithm as follows.

In the process of determining the congestion degree, T_a is updated periodically whenever there are n (=50 in CAA) new packets arriving as follows:

$$T_a = (1 - \omega_a) * T_a + \omega_a T_n / n \tag{2}$$

where $0 < \omega_a < 1$ is a constant (= 0.1 in CAA), T_n is the time interval over which the measurements are performed, and within which the n new packets arrive.

Also, T_s is updated each time a packet is forwarded as follows:

$$T_s = (1 - \omega_s) * T_s + \omega_a T'_n / n \tag{3}$$

Where $0 < \omega_s < 1$ is a constant (= 0.1 in CAA).

Definition 4.3. Congestion degree CD . The ratio of average packet service time over average packet inter-arrival time over a pre-specified time interval in each senor node i.

$$C_{CD} = (T_s / T_a) \times L_{CH_i} \tag{4}$$

Congestion degree reflect the congestion level of the node i. Congestion bits settled in each sensor node to indicate congestion degree, denote CB .Set two threshold β_1 and β_2 .Detail detection rule is:

Rule 1. If $CD > \beta_1$ (β_1 =0.2 in CAA), the congestion position is set to 10, denotes general congestion. The congested CH starts to send the *via* backpressure message contains CD and C_{bit} to suppress the upstream node to continue to transmit the data.

Rule 2. If $CD > \beta_2$ (β_2 =0.5 in CAA), the congestion position is set to 11, denotes serious congestion. To issue congestion information contains CD and C_{bit} to the upstream *CHs* and forward data to sink through altering route.

Rule 3. If $CD < \beta_1$, the congestion position reset to 00, Inform upstream *CHs* congestion has eased.

5.1 Congestion Control

In wireless sensor networks, each node of data collection and allocation of time slots within the first data sent to the cluster. In order to make the minimum energy consumption, only members of each cluster in the allocated time slot to activate communication channel, and the other time channel is sleeping. Cluster the first cluster of each round will be sent to collect the data, data fusion and transmitted to the base station.

After each CH collect data, it select path from candidate parents CH according to their congestion degree mentioned in section 4. We will not consider those whose congestion degree is already above the hotspot proximity threshold. If we set the hotspot proximity threshold at 0.5, then CH_3 from figure 1 will not be considered. We use the term qualified candidate nodes to denote all the nodes whose congestion level is below the hotspot proximity threshold and energy level is above a certain threshold.

5.2 Local Data Storage

If a CH does not have any qualified candidate parent CHs to forward data for congestion, it transfer part of the data to local buffer node to act as data buffers during congestion periods in order to avoid data loss.

6 Performance Evaluation

In the simulations, we use NS2 to simulate the DEBC protocol performance. The network area is 500m×500m and the number of the sensor nodes is 100. Figure 1 shows the parameter when we compare CAA with LEACH.

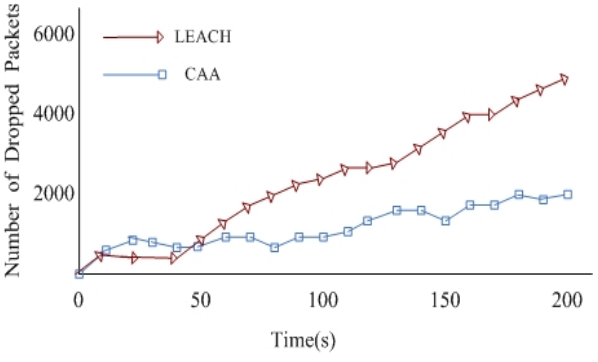

Fig. 1. Packet Drop Rate in the Network

The total source rate is defined as the total number of data packets generated by the data sources per second. Figure 2 compares the total source rates of the schemes with respect to time. During the course of congestion avoidance, the total source rates are reduced. At around time = 200 seconds, congestions in CAA are removed and the total source rates stabilize. CAA achieves the best source rate due to its capability of redirecting traffic towards other downstream paths that are not congested. LEACH treats all sources in the same way as it treats the one whose downstream paths are most congested. Backpressure falls in the middle. Combining with the results in Figure 1, we see a tradeoff between the number of dropped packets and the total source rate. By more aggressively reducing the rates in response to congestion.

The three congestion control/avoidance schemes use the same shortest-path routing algorithm. Hence, the routing distance from the same data source to the sinks is always the same for all schemes. If distant data sources send less, then the average routing distance per packet will be smaller, and vice versa. No congestion control is the fairest scheme because all data sources send at the same rate. So its average routing distance sets a benchmark. For other schemes, the less the distant nodes send, the smaller the average routing distance will be. Figure 3 shows that CAA has the smaller routing distance, which means nodes closer to the base station send much more than their fair share. The routing distance of CAA is much closer to that of Global Rate Control, which means distant nodes are penalized much less.

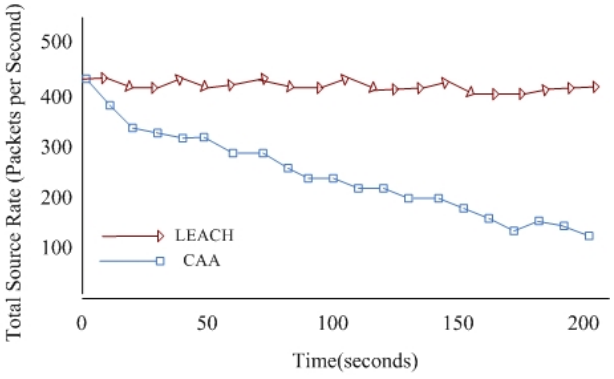

Fig. 2. Packet Drop Rate in the Network

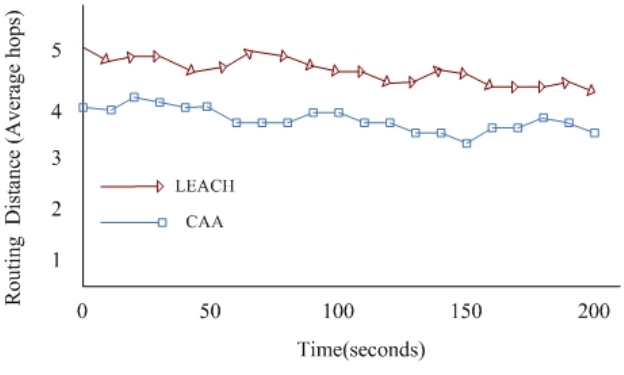

Fig. 3. Average Routing Distance of Each Packet

Figure 4 shows the average routing delay per packet after the congestions are removed. The end-to end routing delay is mostly determined by the number of hops and per hop queuing delay. Backpressure fully utilizes the buffer space. Consequently the average routing delay decreases when the average routing distance decreases, which happens when the number of data sources increase. Due to the buffer solution, the queue length in CAA will be kept smaller than the buffer size, which means it has smaller per-hop delay than Backpressure. However, Backpressure still has smaller end-to-end delay due to its smaller routing distance.

The average energy expenditure is defined as the total number of transmissions made in the network divided by the number of packets delivered to the sinks. One transmission moves a packet one hop closer to a sink. Figure 4 shows how the average energy expenditure changes over time. Congestion Avoidance is more energy efficient than Global Rate Control because the latter drops many packets, which waste a lot of transmissions. Backpressure has the lower energy expenditure because it is not fair to the distant sensors. More packets are generated from the sensors close to the sinks, and it takes less numbers of transmissions to deliver them to the base station.

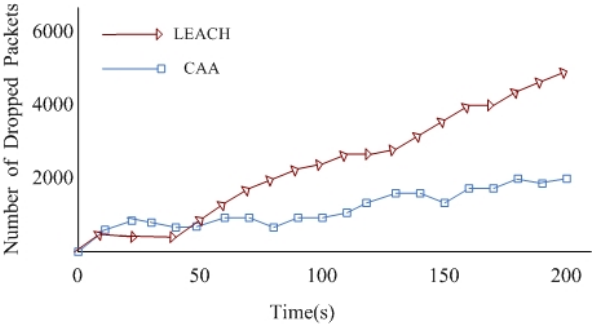

Fig. 4. Routing Delay

This shows that the implementation of the local data storage model will increase the time delay while guaranteeing that all data reaches the sink which was not the case in the first two simulations.

7 Conclusion

In this work, we proposed a novel congestion avoidance and alleviation routing protocol for WSNs. The protocol comprises 3 techniques. First, we propose cognition detection technology to detect the potential congestion timely and effective; Secondly, it attempts to is presented to reallocate traffic with altering route protocol to mitigate congestion, avoid conflict, enhances data transmission reliability of CH; Lastly, the work introduces a congestion data local preservation strategies effectively avoid data lost during the congestion period and guarantee the reliability of data transmission. The protocol provides a network load balancing, effective prolongs the life cycle of the clusters, postpones network system lifetime. In our next work, we will study more real-time congestion control scheme.

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The Research of PDM System for the Collaborative Design of Functional Structure

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Abstract. This article is targeted for collaborative design PDM system structure was studied, according to the collaborative design characteristics of dynamic management, corporate, organization, roles, and members of the four-layer model of organization and management, and collaborative design collaboration mode, the object-oriented projects, task-oriented and object-oriented activities of permission management and Web-based project management and workflow integration technology, enables collaborative design alliance enterprise information management and project development in collaboration with the authorization. Finally, the system in manufacturing enterprises in the area of collaborative manufacturing system has been applied verification for collaborative system design provides stable and secure data management platform.

Keywords: Product Data Management(PDM), collaboration authorized, union enterprises, regional collaborative.

1 Introduction

In the increasingly fierce market competition, the enterprise product quality, costs, research and development cycle, and so on place high demands. Enterprises are also aware of the brand's research and development is the enterprise's core competitiveness. It is essential that improve the product design process to shorten the product development and manufacturing cycles, improve product quality, improve product performance. It makes the needs of workflow increased, for collaborative software produces more pressing needs. Most enterprises have been widely implemented PDM system to manage the product-related data and design process, but as the technology's development and progress, product design, the manufacture involves many disciplines and technology categories, enterprises need to join together, forge alliances and collaborative design, common in the face of market competition and needs. And collaborative design of the entire business process may span multiple enterprises, thereby raising multiple enterprises, many officers, organization of complex coordination issues, staff of project ownership, ownership and Organization Department constantly changes, task vested with responsibility, resource ownership and permission assignments should be adjusted accordingly, and traditional PDM system capabilities structure and operating mechanisms already cannot meet the requirements of the collaborative design and, therefore, for collaborative design PDM system came into being.

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We are on the functional structure and operating mechanisms for design and research: organization structure changes frequently, enterprises, organizations, people, and the role of the fourth level of organizational management structure model, guarantee a leader on enterprise management; according to object-oriented projects, task-oriented and object-oriented activities of the collaboration model, providing object-oriented collaboration model and object-oriented model of rights management, achieving a synergy between enterprises; proposed authorization, Web-based project management and workflow systems, realization of the project file, the design process and personnel information integration, ensure collaborative design process leader on enterprise information management and process control.

2 PDM System Architecture

Product data management (PDM) is a software-based, product life cycle management and product-related information and process technology, and product-related information including: product data, such as CAD/CAE/CAM documents, materials, product profiles, transaction files, product orders, electronic forms, production costs, the supplier status.

Product - related process including process of product - related, processing instructions and approval of the document, use rights, standards and methods of work, work procedures, organization of workflow process. etc. PDM is the key to enterprise information integration, enterprise-wide for product design and manufacturing of the establishment of a parallel collaborative environment. Therefore, it is a collaborative design provides the Foundation for the environment, set the database's data management capabilities, network communication capabilities and process control in one, can be realized in a distributed environment design and manufacturing activities of information exchange and sharing of design and manufacturing process for dynamic adjustment and monitoring, is also well supported various subsystems of collaborative work, support the optimization in the allocation of resources.

PDM must have five functional modules: product configuration management, document management, project management, workflow management, classification code management. Currently, the PDM system is already in widespread use and implementation of development has been relatively mature, but its collaborative design of enterprise management, information sharing there are still inadequate. Therefore, this article on the Internet the PDM system of functional structure and operating mechanisms for research, increased Union enterprise information management, rights assignment, and so on, has guaranteed the Union enterprise between collaborative design process management and information sharing. PDM system architecture based on the internet as shown in figure 1 below.

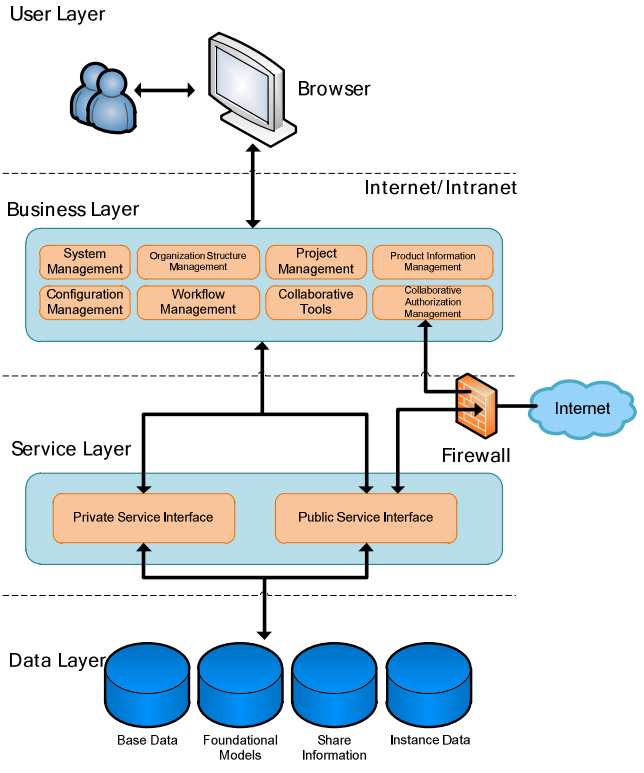

Fig. 1. PDM system based on the network environment system diagram

In Figure 1, the Union shall have an independent enterprise product data management capabilities, but as the product of collaborative design, the inevitable one individual enterprises (the leader), multiple collaboration supporting enterprises, while giving companies hold key information for collaborative design, but also must share with the collaborative enterprise and, therefore, some information PDM system needs through their provision of public services interface. These internal networks and external networks in General through the firewall for isolation.

(1) System for the data storage layer, store the entire product data management system for the final data, including various types of drawings, documents, products, data structures, and other information.

(2) Second-tier layer for system services, mainly through the underlying data access, and related data for initial treatment of logic, the results of the work submitted to the system, the business layer. Service interfaces are divided into private service interfaces and public service interface, private service interface is mainly local PDM system service, complete the logical address of the local data; public service interface not only serves the local PDM system, but also for external collaboration Enterprise collaborative design system provides related services.

(3) The third layer is the business layer, the disposal system of the client browser requests, completed the PDM system of logic, and through collaborative enterprise management, project management and workflow, based on the integration of complete offsite data.

(4) The top layer for user, using a Web browser as the user interface, completing user interaction of the various data of the PDM system, is the client of the PDM system.

3 PDM System Operation Mechanism

3.1 Organization Management

Organization is formed by people, mutual cooperation between people, you can complete the single cannot complete the task, this is the reason for the existence of basic organization, and to complete this basic mission of the Organization, the need for mutual collaboration between people, sharing information, complete the common goals.

General information systems, organizational structures need only consider the internal organization, personnel, and the role it can meet the normal system operation, but for a network of collaborative design system, which not only need to control the internal organization, personnel, and roles, but also to participate in the collaborative design of collaborative enterprise personnel management, therefore, for collaborative design the PDM system of organizational structure to manage the inevitable need for traditional PDM system to improve on.

Organization structure of PDM system for collaborative design of dynamic union should have the following characteristics: (1)synergy should be peer entities to ensure that all levels of organization and technology secrecy and interests; (2)group in collaboration is unrestricted, non-constrained; (3)design groups and group synergies is restricted, there are constraints; (4)organizational structure is dynamic.

Therefore, based on the above characteristics, in building Web-based collaborative design, the organizational structure of the model, we increase the business layer, divided into leading enterprises and cooperative enterprises, and assign the appropriate organization, roles, staffs. Among them, the organizational structure of the Federal Enterprise in the network design platform for dynamic maintenance and management. After the formation of the Alliance, published in leading enterprise PDM system, composed of leading enterprises of the system administrator on collaborative enterprise and its organization, personnel, to the next step of authorization, task assignments, and other operations, such as Union Organization of dynamic and leading enterprise information security.

3.2 Permissions Management

Traditional PDM system, enterprises can have a browse inside the default permissions for all the information, and for collaborative environment of Union enterprises which cannot ensure enterprise information security and privacy, while at the same time, since the different enterprise collaboration, Union enterprises also need to browse and collaborative design related documents, drawings, in order to ensure the smooth

progress of collaborative work. Thus, according to the characteristics of collaborative design, as well as for emergency task processing, organization structure and management model, we set against Union enterprises in two ways: the distribution of competences is based on the collaborative support mode default permissions and object-oriented collaborative authorization permissions.

1) Based on the Collaborative Support Mode Default Permissions: Collaborative process modeling has three collaborative support mode, are project-oriented collaboration mode, task-oriented collaboration pattern and object-oriented activities in collaboration mode. Three modes are completed the collaborative design between enterprises in different levels of collaboration tasks, giving the enterprise has the permissions of all active projects, and for other Union enterprises, we based collaboration model of different developed the following default permissions:

Project-oriented Collaboration Mode: collaboration process, the Alliance officer pursuant to individual organizations, roles, with the participation of all relevant documents, drawings, and other information in browse, edit, delete and other privileges; collaboration, enterprise staff have participated in the project-related information in Browse permissions.

Task-oriented Collaborative Mode: collaboration process, the Alliance officer pursuant to individual organizations, roles, tasks, with the participation of all relevant documents, drawings, and other information in browse, edit, delete and other privileges; collaboration, enterprise staff have participated in the task-related information for browse permissions.

Activities-oriented Collaboration Model: collaboration, Enterprise officer pursuant to individual organizations, roles, with the participation of all relevant documents, drawings, and other information in browse, edit, delete and other privileges; collaboration, enterprise staff have participated in activities related to information browsing permissions.

2) Object-oriented Collaborative Grant Permissions: Collaborative design process, the Union enterprise between may need to refer to the leading enterprises in the information or material in the past, but because the default permissions settings, it does not have permission to browse information. Therefore, we propose a object-oriented, collaborative grant permission provides leading enterprises can apply specific objects (such as folders, parts, drawings, documents, etc.) or an object class of permissions granted to the collaborative enterprise or collaborative enterprise-specific departments, roles, people, or the specific role of enterprise collaboration, collaborative grant permission to ensure the quality of the current project and smoothly, permissions diagram shown in Figure 2.

3.3 Web-Based Project Management and Workflow Integration

In collaborative design system, since the enterprise project management and enterprise workflow management is decentralized, and to realize the true meaning of collaborative design, and ensure the leading enterprises for projects and processes of monitoring, you will need to be collaboration between enterprises in the project file, people, information and process integration, and implementation of Web-based project management and workflow integration.

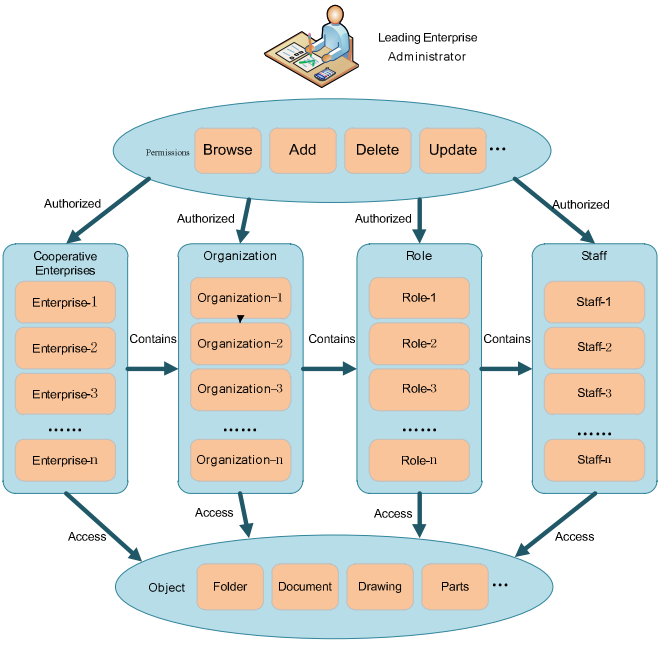

Fig. 2. Four structure of the permissions diagram

1) Project File Integration: Project files are the project management (Project Management, PM) system for project schedule management, task tracking, and resource allocation, and pursuant to the project team to work together. Collaborative design system will integrate the project files to the PDM system, PDM document security mechanisms to ensure that project files through PDM platforms in the project group members shared between security.

2) Staff Information Integration: PDM user involvement in product design and human resources from its organization management module management, human resources, the PDM to its product development process roles, functions, competence, organization, management, and project management is in the project from the project to finish the whole process for HR work tasks, functions, roles, plan, status, effectiveness, and cost management. Integration must remain both staff information complete, consistent, and uniform resource allocation.

3) Process Integration: In the project management system, often a complex project into multiple child items, each item can be further decomposed into multiple tasks. Project management implementation by task tracking, project monitoring, the process is to PDM reaches a certain of the purposes of a series of activities. PDM system, the purpose of the process can be defined as a project management system task, that is, the PDM system process can and project management system tasks. Therefore, the PDM process and project management tasks associated with, the use of PDM process management can achieve project task tracking and project monitoring.

Therefore, the project management system and PDM workflow management, integration, PDM platform in addition to project files sharing, you need to project management system for project management, project monitoring, and other functions and PDM system for process management integrated with, the use of the PDM system of process management implementation tracking project tasks. At the same time, you also need integrated collaborative enterprise implementation of human resources, between project resource provisioning, the unity of the project personnel information. Figure 3 represents a project management system and PDM process management information interactive chart.

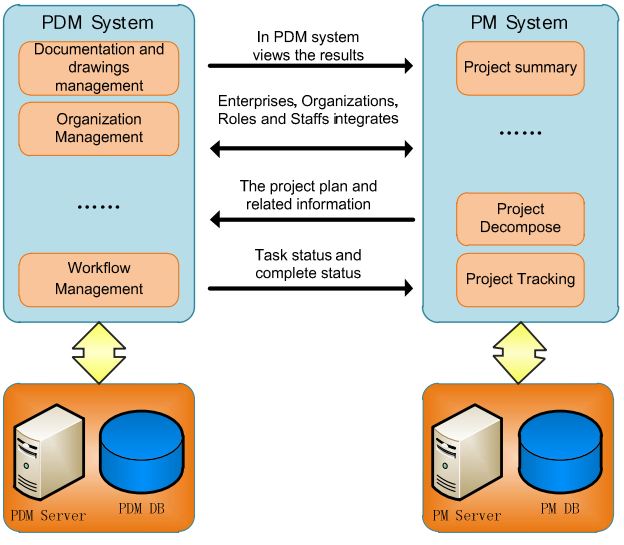

Fig. 3. Project management system interacts with PDM process management information chart

4 Validation for PDM System Application

Through the study of the theory, networked environment of PDM system developed and traditional PDM system run by a different mechanism, meet the collaborative design process Alliance between enterprise's dynamics, integration and security requirements. Via embedded in Zhejiang Province science and Technology Department of a major scientific and technical key project, "the development of regional cooperative manufacturing system and its machinery manufacturing enterprises promotion", after the user's authentication, illustrates the functionality of the PDM system to meet the requirements of the collaborative design, to extended enterprises to provide safe, reliable and flexible data management features, system modules, as shown in Figure 4.

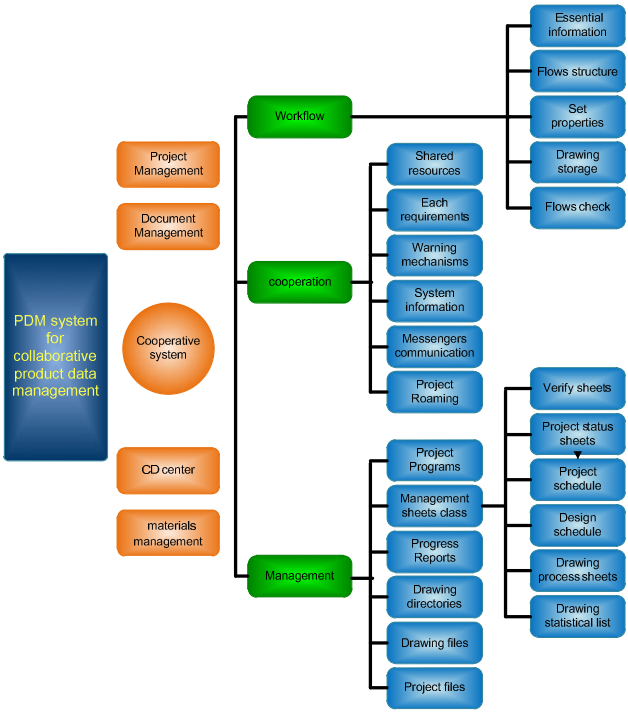

Fig. 4. Regional collaborative manufacturing system modules

5 Summary

As Internet technologies, vendor, consumers and manufacturers is working closely together make it possible to cross-domain, cross-enterprise collaboration design. This article's researches and describes in detail on PDM for collaborative design system structure, and validation for PDM system application in manufacturing enterprises, it provides reliable data management mechanism for enterprises of various types of collaboration mode, improves the efficiency of collaboration between enterprises, thereby effectively enhances the competitiveness of enterprises.

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Robust H_∞ Networked Control for Uncertain Fuzzy Systems with Time-Delay

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Abstract. This paper investigates the problem of robust state feedback H_∞ control for a class of uncertain discrete-time fuzzy systems with time-delays. The state–space Takagi–Sugeno fuzzy model with time delays and norm-bounded parameter uncertainties is adopted. A state feedback controller is designed via the networked control systems(NCSs) theory. The robust controller gain matrices are obtained by solving a set of linear matrix inequalities (LMIs). Sufficient condition for robust stability with H_∞ performance is obtained. Simulation results show that the proposed method is effective.

Keywords: Robust H_∞ control, T-S Fuzzy systems, time-delay, uncertainties, linear matrix inequalities (LMIs).

1 Introduction

Feedback control systems in which the control loops are closed through a real-time network are called networked control systems(NCSs). Such NCSs have received increasing attention in recent years[1,4,5,8,9]. It is well known that the fuzzy control is a useful approach to solve the control problems of nonlinear systems. During the last decade, the stability and stabilization problems for systems in T-S fuzzy model have been studied extensively and many methods have been proposed in [2,4,5,6,8,9].

In this paper, we consider the problem of robust H_∞ networked control for Takagi-Sugeno(T-S) fuzzy systems with time-delay. The Lyapunov-Krasovskii functional approach and free weighting matrix approach are applied to analyse the stability and stabilization problems. A simple and effective fuzzy controller design method is proposed. The effectiveness of the proposed method is shown by an example.

2 Syetem Description and Preliminaries

A typical NCS model with network-induced delays is shown in Fig1, where τ_{SC} is the sensor-to-controller delay and τ_{CA} is the controller-to-actuator delay, respectively.

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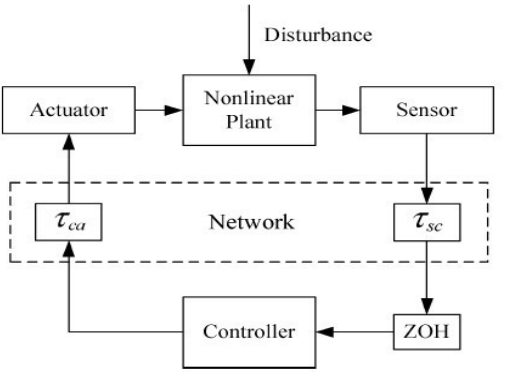

Fig. 1. Framework of networked control system

The plant in Fig1 is a nonlinear plant, which can be described by the following T-S fuzzy model:

Rule j: IF $\xi_1(t)$ is M_{j1}, and …and $\xi_n(t)$ is M_{jn},

THEN $\dot{x}(t) = (A_j + \Delta A_j)x(t) + (B_j + \Delta B_j)u(t) + H_j\omega(t)$

$$z(t) = C_{1j}x(t) + C_{2j}u(t) \quad \text{For j=1,2,…,r} \tag{1}$$

Where $x(t) \in \Re^n$ is the state, $u(t) \in \Re^m$ is the control input, $\omega(t) \in \Re^n$ is the disturbance input vector. $z(t) \in R^q$ is the controlled output, r and n are the numbers of rules and state variables. A_j, B_j, ΔA_j, ΔB_j and H_j, C_{1j}, C_{2j} are matrices with appropriate dimensions. M_{jg} is the fuzzy set ($g = 1,2,...,n$) and $\xi_1(t), \xi_2(t), \ldots, \xi_n(t)$ are the premise variables.

$$h_j(\xi(t)) = \frac{\mu_i(\xi(t))}{\sum_{i=1}^{r}\mu_i(\xi(t))}, and\ \mu_i(\xi(t)) = \prod_{g=1}^{n} M_{ig}(\xi(t))$$

$$h_j(\xi(t)) \geq 0,\ j = 1,...,r \quad and \quad \sum_{j=1}^{r} h_j(\xi(t)) = 1$$

According to the assumptions of the networked control system and the literature[4], considering the network behavior and the influence of network time-delay, and by using product inference, singleton fuzzifier, and center-average defuzzifer, the inferred system (1) can be expressed by (2):

$$\begin{aligned} x(k+1) &= \sum_{i=1}^{r} h_i(\xi(k))(A_i + \Delta A_i)x(k) + (\bar{A}_i + \Delta\bar{A}_i)x(k-d_1) \\ &\quad + (B_i + \Delta B_i)u(k) + (\bar{B}_i + \Delta\bar{B}_i)u(k-d_2) + H_j\omega(k) \\ z(k) &= \sum_{i=1}^{r} h_i(\xi(k))C_{1i}x(k) + C_{2i}u(k) \end{aligned} \tag{2}$$

where $0 \le d_i < \infty\ (i = 1,2)$ are the constant time-delays,

$$A_i + \Delta A_i = e^{(A_j + \Delta A_j)h} \quad , \quad H_i = \int_0^{h-\tau_k} e^{(A_j + \Delta A_j)t} dt H_j$$

$$B_i + \Delta B_i = \int_0^{h-\tau_k} e^{(A_j + \Delta A_j)t} dt \left(B_j + \Delta B_j\right)$$

Due to the coefficient matrices are time-varying matrices with random time-delays, then assuming parameter uncertainty is norm bounded and has the following form:

$$\left[\Delta A_i \ , \Delta \overline{A}_i \ , \Delta B_i \ , \Delta \overline{B}_i\right] = DF(k)\left[E_{1i} \ , E_{2i} \ , E_{3i} \ , E_{4i}\right],$$

where D , E_{1i} , E_{2i} , E_{3i} , E_{4i} are constant matrices with appropriate dimensions, and $F^T(k)F(k) \le I$, $(\forall k)$.

Now we design the controller as the following form in order to stabilize the closed-loop system:

Control rule i:

IF $\xi_1(k)$ is M_{i1}, and …and $\xi_n(k)$ is M_{in},

THEN $u(k) = K_i x(k)$, $i = 1,2,...,r$

where K_i are control gains to be determined. Then the natural choice of a state feedback controller is the following :

$$u(k) = \sum_{i=1}^{r} h_i(\xi(k)) K_i x(k) \tag{3}$$

Then the closed-loop system can be expressed as :

$$\begin{aligned} x(k+1) = \sum_{i=1}^{r}\sum_{i=1}^{r} h_i h_j(\xi(k))\{ & [(A_i + \Delta A_i) + (B_i + \Delta B_i)K_j] \\ & x(k) + (\overline{A}_i + \Delta \overline{A}_i)x(k-d_1) + (\overline{B}_i + \Delta \overline{B}_i)K_j x(k-d_2) \\ & + H_j \omega(k)\} \\ z(k) = \sum_{i=1}^{r}\sum_{i=1}^{r} & h_i h_j(\xi(k))(C_{1i} + C_{2i}K_j)x(k); \end{aligned} \tag{4}$$

3 Main Results

The objective of this paper is to find state feedback gains K_i in the control law (3) that stabilizes system (4) with H_∞ performance $\|z\|_2 < \gamma \|\omega\|_2$.

Theorem 1: Given scalar $\gamma > 0$, if there exist matrices $P > 0$, $R_1 > 0$, $R_2 > 0$, $S_1 > 0$, $S_2 > 0$ and W_1, W_2, M_{1Z}, M_{2Z} with appropriate dimensions , as well as the scalar $\varepsilon > 0$, such that the LMIs hold in (5) , (6)

$$\begin{bmatrix} \lambda_1 & \lambda_2 & \lambda_3 & \lambda_4 & \lambda_5 \\ * & -R_1 & 0 & 0 & E_{2i}^T \\ * & 0 & -R_2 & 0 & K_j^T E_{4i}^T \\ * & 0 & 0 & -\gamma^2 I & 0 \\ * & * & * & 0 & -\varepsilon I \end{bmatrix} < 0 \tag{5}$$

$$\begin{bmatrix} W_1 & M_{1Z} \\ * & S_1 \end{bmatrix} \geq 0, \qquad \begin{bmatrix} W_2 & M_{2Z} \\ * & S_2 \end{bmatrix} \geq 0 \tag{6}$$

Then the system (4) is asymptotically stable, where

$$\lambda_1 = \psi + \varepsilon G^T \begin{bmatrix} 0 & 0 \\ 0 & DD^T \end{bmatrix} G, \lambda_2 = G^T \begin{bmatrix} 0 \\ \overline{A}_i \end{bmatrix} - M_{1Z}$$

$$\lambda_3 = G^T \begin{bmatrix} 0 \\ \overline{B}_i K_j \end{bmatrix} - M_{2Z}, \qquad \lambda_4 = G^T \begin{bmatrix} 0 \\ H_i \end{bmatrix}$$

$$\lambda_5 = \begin{bmatrix} E_{1i}^T + K_j^T E_{3i}^T \\ 0 \end{bmatrix}, \qquad G = \begin{bmatrix} P & 0 \\ P_1 & P_2 \end{bmatrix}$$

$$\psi = G^T \begin{bmatrix} 0 & I \\ A_i + B_i K_j - I & -I \end{bmatrix} + \begin{bmatrix} 0 & \left(A_i + B_i K_j - I\right)^T \\ I & -I \end{bmatrix} G$$

$$+ \begin{bmatrix} R_1 + R_2 + C_{1i}^T C_{1i} & 0 \\ 0 & P + d_1 S_1 + d_2 S_2 \end{bmatrix} + d_1 W_1 + d_2 W_2$$

$$+ \begin{bmatrix} M_{1z} & 0 \end{bmatrix} + \begin{bmatrix} M_{1Z}^T & 0 \end{bmatrix}^T + \begin{bmatrix} M_{2z} & 0 \end{bmatrix} + \begin{bmatrix} M_{2Z}^T & 0 \end{bmatrix}^T$$

Proof:

We can choose the following Lyapunov–Krasovskii functional:

$$V(k) = V_1(k) + V_2(k) + V_3(k) \tag{7}$$

$$V_1(k) = x^T(k) P x(k)$$

$$V_2(k) = \sum_{s=k-d_1}^{k-1} x^T(s) R_1 x(s) + \sum_{s=k-d_2}^{k-1} x^T(s) R_2 x(s)$$

$$V_3(k) = \sum_{\theta=0}^{1-d_1} \sum_{s=k-1}^{k-1+\theta} x^T(s) S_1 x(s) + \sum_{\theta=0}^{1-d_2} \sum_{s=k-1}^{k-1+\theta} x^T(s) S_2 x(s)$$

When $\omega(k) = 0$, consider the forward difference, and use the lemma referred in [6], then we can obtain

$$\Delta V(k) = \Delta V_1(k) + \Delta V_2(k) + \Delta V_3(k)$$

$$\leq \begin{bmatrix} x^T(k) \\ x^T(k-d_1) \\ x^T(k-d_2) \end{bmatrix}^T \begin{bmatrix} \psi & \lambda_6 & \lambda_7 \\ * & -R_1 & 0 \\ * & 0 & -R_2 \end{bmatrix} \begin{bmatrix} x(k) \\ x(k-d_1) \\ x(k-d_2) \end{bmatrix} \tag{8}$$

where

$$\lambda_6 = G^T \begin{bmatrix} 0 & \overline{A_i} + \Delta\overline{A_i} \end{bmatrix}^T - M_{1Z},$$

$$\lambda_7 = G^T \begin{bmatrix} 0 & (\overline{B_i} + \Delta\overline{B_i})K_j \end{bmatrix}^T - M_{2Z}$$

$$G = \begin{bmatrix} P & 0 \\ P_1 & P_2 \end{bmatrix}$$

$$\psi = G^T \begin{bmatrix} 0 & I \\ (\overline{A_i} + \Delta\overline{A_i}) + ((\overline{B_i} + \Delta\overline{B_i}))K_j - I & -I \end{bmatrix} + \begin{bmatrix} 0 & ((A_i + \Delta A_i) + (B_i + \Delta B_i)K_j - I)^T \\ I & -I \end{bmatrix} G + \begin{bmatrix} R_1 + R_2 & 0 \\ 0 & P + d_1 S_1 + d_2 S_2 \end{bmatrix} + d_1 W_1 + d_2 W_2 + \begin{bmatrix} M_{1z} & 0 \end{bmatrix} + \begin{bmatrix} M_{1Z}^T & 0 \end{bmatrix}^T + \begin{bmatrix} M_{2z} & 0 \end{bmatrix} + \begin{bmatrix} M_{2Z}^T & 0 \end{bmatrix}^T$$

Using the Schur complement and the Lemma referred in [5], and considering the inequality (5), we can obtain $\Delta V(k) < 0$, then the the system (4) is asymptotically stable.

For any $\omega(k) \in L_2[0,\infty], \omega(k) \neq 0$, using the Lemma referred in [5] again, we can obtain

$$\Delta V + z^T(k)z(k) - \gamma^2 \omega^T(k)\omega(k) \leq \Gamma^T(k)\left(\Theta + \varepsilon \overline{D}\overline{D}^T + \varepsilon^{-1}\overline{E}^T\overline{E}\right)\Gamma(k) \quad (\forall \varepsilon > 0)$$

where $\Theta = \begin{bmatrix} \psi & \lambda_8 & \lambda_9 & \lambda_{10} \\ * & -R_1 & 0 & 0 \\ * & 0 & -R_2 & 0 \\ * & 0 & 0 & -\gamma^2 I \end{bmatrix}$

$$\lambda_8 = G^T \begin{bmatrix} 0 \\ \overline{A_i} \end{bmatrix} - M_{1Z}, \quad \lambda_9 = G^T \begin{bmatrix} 0 \\ \overline{B_i}K_j \end{bmatrix} - M_{2Z}$$

$$\lambda_{10} = G^T \begin{bmatrix} 0 \\ H_i \end{bmatrix}, \quad \overline{D}^T = \begin{bmatrix} 0, D^T G, 0, 0 \end{bmatrix}$$

$$\Gamma^T(k) = \begin{bmatrix} x^T(k), x^T(k-d_1), x^T(k-d_2), \omega^T(k) \end{bmatrix}$$

$$\overline{E} = \begin{bmatrix} E_{1i} + E_{3i}K_j, 0, E_{2i} + E_{4i}K_j, 0 \end{bmatrix}$$

Using the Schur complement and (5) , we can obtain

$$\Delta V + z^T(k)z(k) - \gamma^2\omega^T(k)\omega(k) < 0 \quad (\forall k > 0)$$

By letting $N > 0$ and under zero initial condition,

$$\sum_{i=1}^{N} z^T(k)z(k) - \gamma^2\sum_{i=1}^{N}\omega^T(k)\omega(k) < -V(N) \le 0$$

Then the performance H_∞ can be satisfied, for $\|z\|_2 < \gamma\|\omega\|_2$.

Theorem 2: Considering the system (4) and the state feedback controller (3) , if there exist matrices $X > 0$, $\overline{R} > 0_1$, $S_1 > 0$, $S_2 > 0$, $N > 0$ and $\overline{W}_{11}, \overline{W}_{12}, \overline{W}_{13}, \overline{W}_{21}, \overline{W}_{22}, \overline{W}_{23}, Y, Z, \overline{K}_j$ with appropriate dimensions, as well as the scalars $\varepsilon > 0$, constant scalars $\delta_1, \delta_2, \sigma_1, \sigma_2$ and the following inequalities hold

$$\begin{bmatrix} \overline{W}_{11} & \overline{W}_{12} & 0 \\ * & \overline{W}_{13} & \delta_1\overline{A}_i\overline{S}_1 \\ * & * & \overline{S}_1 \end{bmatrix} \ge 0, \tag{9}$$

$$\frac{1}{r-1}\theta_{ii} + \frac{1}{2}(\theta_{ij} + \theta_{ji}) < 0 \qquad (\theta_{ii} < 0) \tag{10}$$

$$\frac{1}{r-1}\rho_{ii} + \frac{1}{2}(\rho_{ij} + \rho_{ji}) < 0 \qquad (\rho_{ii} < 0) \tag{11}$$

Then the system (4) is asymptotically stable with an H_∞ performance for the prescribed γ, and

$$u(k) = \sum_{i=1}^{r} h_i(\xi(k))\overline{K}_j X^{-1} x(k) \ , \ 1 \le i \ne j \le r$$

where,

$$\rho_{ij} = \begin{bmatrix} \Omega_1 & \Omega_2 & 0 & 0 & 0 & \lambda_{13} & \Omega_5 \\ * & \Omega_3 & \lambda_{11} & \lambda_{12} & H_i & 0 & 0 \\ * & * & -\overline{R}_1 & 0 & 0 & \overline{R}_1 E_{2i}^T & 0 \\ * & * & * & -N & 0 & \overline{K}_j^T E_{4i}^T & 0 \\ * & * & * & * & -\gamma^2 I & 0 & 0 \\ * & * & * & * & * & -\varepsilon I & 0 \\ * & * & * & * & * & * & -\Omega_4 \end{bmatrix}$$

$$\lambda_{11} = (1-\sigma_1)\overline{A}_i\overline{R}_1, \ \lambda_{12} = (1-\sigma_2)\overline{B}_i\overline{K}_j,$$

$$\lambda_{13} = XE_{1i}^T + \overline{K}_j^T E_{3i}^T \Omega_1 = Z + Z^T + d_1\overline{W}_{11} + d_2\overline{W}_{21} + N$$

$$\Omega_2 = Y + XA_i^T + \overline{K}_j^T B_i^T - X - Z^T + \sigma_1 XA_i^T + \sigma_2 \overline{K}_j^T B_i^T + d_1\overline{W}_{12} + d_2\overline{W}_{22}$$

$$\Omega_3 = -Y - Y^T + \varepsilon DD^T + d_1\overline{W}_{13} + d_2\overline{W}_{23}$$

$$\Omega_4 = diag\left(\overline{R}_1, I, X, d_1\overline{S}_1, d_2\overline{S}_2\right)$$

$$\Omega_5 = \begin{bmatrix} X & XC_i^T & Z^T & d_1Z^T & d_2Z^T \\ 0 & 0 & Y^T & d_1Y^T & d_2Y^T \end{bmatrix}$$

$$\theta_{ij} = -\begin{bmatrix} \overline{W}_{21} & \overline{W}_{22} & 0 \\ * & \overline{W}_{23} & \delta_2\overline{B}_i\overline{K}_j \\ 0 & * & X\overline{S}_2^{-1}X \end{bmatrix}$$

Proof: Let $M_{1Z} = \delta_1 G^T\left[0, \overline{A}_i\right]^T, M_{2Z} = \delta_2 G^T\left[0, \overline{B}_i K_j\right]^T$,

then

$$G^{-1} = \begin{bmatrix} P^{-1} & 0 \\ -P_2^{-1}P_1P^{-1} & P_2^{-1} \end{bmatrix}, \quad X = P^{-1}, \quad Z = -P_2^{-1}P_1P^{-1} \quad Y = P_2^{-1}, \quad \overline{R}_1 = R_1^{-1},$$

$$N = X^T R_2 X, \overline{K}_j = K_j X\left(G^{-1}\right)^T W_1 G^{-1} = \begin{bmatrix} \overline{W}_{11} & \overline{X} \\ * & \overline{W}_{13} \end{bmatrix}$$

$$\left(G^{-1}\right)^T W_2 G^{-1} = \begin{bmatrix} \overline{W}_{21} & \overline{W}_{22} \\ * & \overline{W}_{23} \end{bmatrix}, \overline{S}_1 = S_1^{-1}, \overline{S}_2 = S_2^{-1}$$

By the method stated in [7], and from inequality (10) and (11), we know

$$\begin{aligned} &\sum_{i=1}^{r}\sum_{j=1}^{r} h_i\left(\xi(k)\right)h_j\left(\xi(k)\right)\varsigma_{ij} \\ &= \frac{1}{r-1}\sum_{i=1}^{r} h_i^2\varsigma_{ii} + \frac{1}{2}\sum_{i=1}^{r}\sum_{i<j}\left(\varsigma_{ij} + \varsigma_{ji}\right) < 0 \end{aligned} \tag{12}$$

Multiply (5) by $diag\left(G^{-1}, \overline{R}_1, X, I, I\right)$ on the left and $diag\left(\left(G^{-1}\right)^T, \overline{R}_1, X, I, I\right)$ on the right, respectively, then we know the (5) is equivalent to (12). According to the Schur complement, and the (5) hold on the basis of (11).

In a same way, multiply the first inequality in (6) by $diag\left(\left(G^{-1}\right)^T, \overline{S}_1\right)$ on the left and $diag\left(G^{-1}, \overline{S}_1\right)$ on the right, respectively; Multiply the second inequality in (6) by

$diag\left(\left(G^{-1}\right)^T, X\right)$ on the left and $diag\left(G^{-1}, X\right)$ on the right. Then the first inequality in (6) holds on the basis of (9) and the second inequality in (6) hold on the basis of (10).

4 Simulation

To illustrate the developed H_∞ controller design approach for the NCSs, we consider the following example.

Rule 1: IF x_1 is μ_1, THEN

$$x(k+1)=(A_1+\Delta A_1)x(k)+(\overline{A}_1+\Delta\overline{A}_1)x(k-d_1)$$
$$+(B_1+\Delta B_1)u(k)+(\overline{B}_1+\Delta\overline{B}_1)u(k-d_2)+H_1\omega(k);$$

IF x_1 is μ_2, THEN

$$z(k)=C_{11}x(k)+C_{21}u(k);$$
$$x(k+1)=(A_2+\Delta A_2)x(k)+(\overline{A}_2+\Delta\overline{A}_2)x(k-d_1)$$
$$+(B_2+\Delta B_2)u(k)+(\overline{B}_2+\Delta\overline{B}_2)u(k-d_2)+H_2\omega(k);$$

we assume that

$$z(k)=C_{12}x(k)+C_{22}u(k);$$

$x_1(k)\in[-0.5,0.5]$, and select the membership function as $\mu_1=\dfrac{(1-\cos x_1)}{2}$, $\mu_2=1-\mu_1$,

and $\omega(k)=\sin(2\pi k)$,

$$A_1=\begin{bmatrix}0 & 1\\ -0.01 & 0\end{bmatrix},\quad A_2=\begin{bmatrix}0 & 1\\ -0.5 & 0\end{bmatrix}$$
$$B_1=B_2=\begin{bmatrix}0 & 1\end{bmatrix}^T,\quad C_{11}=C_{12}=\begin{bmatrix}0 & 1\end{bmatrix}^T$$
$$C_{21}=C_{22}=0,\quad H_1=H_2=\begin{bmatrix}-2 & 1\end{bmatrix}^T$$

We set $\delta_1=0.2,\delta_2=0,\varepsilon=0.3,d_1=2,d_2=1,$

$$N=a_1X,\ \overline{S}_2=a_2X,\ a_1=0.01,\ a_2=10000,$$

$\gamma=0.04$, then we can obtain the controller gain matrices

$$K_1=\begin{bmatrix}-0.0045 & -0.0070\end{bmatrix},\quad K_2=\begin{bmatrix}-0.0021 & -0.0067\end{bmatrix}$$

The simulation results of the state response of the nonlinear system are given in Fig. 2.

From the simulation results, it can be seen the designed fuzzy output feedback controller ensures the robust asymptotic stability of the closed-loop system and guarantees a prescribed H_∞ performance level.

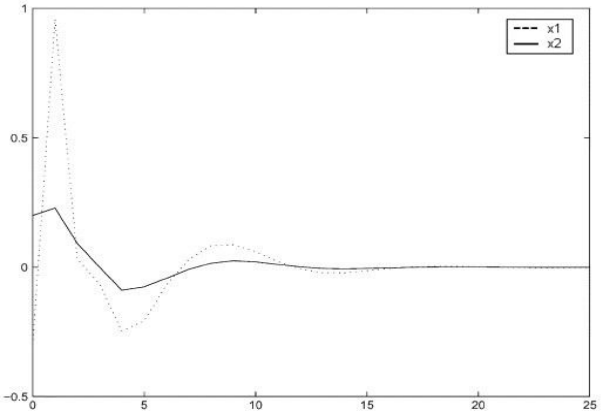

Fig. 2. State response of x_1 and x_2 with h = 0.05s and $\tau_k \in$ [0,0.045]s

5 Conclusion

The problem of robust output feedback H_∞ control for uncertain discrete T–S fuzzy systems with uncertainties and time delays has been studied. A sufficient condition of the fuzzy output feedback controller has been obtained.

The design approach has been applied to the problem of robust H_∞ control of a class of nonlinear discrete delay systems, and the simulation results have showed the effectiveness of the proposed approach.

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A New Load Balancing Strategy in Relay Enhanced Cellular Networks with Multiple Traffic Types

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Abstract. In relay enhanced cellular networks, many call requests in hot cells are blocked due to unbalanced traffic load, and it may be more serious in the networks with multiple traffic types. Therefore, load balancing is an important problem in relay enhanced cellular networks. In this paper, we consider two types of services, which are real-time (RT) and non-real-time (NRT) services. Firstly, we formulate the load balancing problem as an optimization problem, and then a five-step strategy with low complexity is proposed to solve it. When new calls come, we give the RT service priority and decrease the allocated subchannels of NRT users dynamically to satisfy more users' requests of accessing the network. Furthermore, we utilize cell selection and handover schemes of mobile stations (MSs) and relay stations (RSs) to transfer traffic from hot cells to cooler ones. Simulation results indicate that the proposed strategy can reduce the new call blocking probability significantly, and guarantee the high priority of RT users.

Keywords: Load balancing, relay, cellular networks, multiple traffic, handover.

1 Introduction

Introducing relay stations (RSs) to cellular networks can extend cell coverage and enhance signal strength for boundary users [1]. However, it makes the load balancing problem more complicated. On the other hand, load balancing scheme can achieve better performace when the RSs are utilized effectively. In recent years, more and more researches focus on the load balancing problem in relay enhanced network.

In order to balance the load among different cells, it is needed to transfer some traffic from hot cells to neighboring cooler ones. In traditional cellular networks, some load balancing strategies have been proposed [2-4]. The strategies of load balancing are based on power control and cell breathing [2], channel borrowing [3] or introducing ad-hoc relays [4]. While these strategies can't be used in relay enhanced cellular network immediately. The main researches of load balancing strategy in relay enhanced networks are illustrated in [5-9]. An effective relay based load balancing scheme which employs traffic transferring and channel borrowing is presented in [5]. A cell-cluster based traffic load balancing strategy is proposed in [6]. References [7-9] accommodate the unbalanced traffic problem via handover of MSs and RSs. All the above research focus on single traffic type, however, there will be multiple traffic types

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in the next generation wireless communication systems. The load balancing problem will be more complicated.

In this paper, we formulate the load balancing problem in relay enhanced cellular networks with multiple traffic types as an optimization problem, and present a heuristic load balancing strategy with low complexity. Also, we dynamically control the relationships of MSs, RSs and BSs to transfer traffic from hot cells to cooler ones and decrease the allocated subchannels of NRT MSs to allow more users to access the network.

The rest of the paper is organized as follows: Section 2 provides the system model and problem description. In section 3, we present a five-step strategy. Section 4 provides simulation results. In section 5, we conclude this paper.

2 System Model and Problem Description

2.1 Relay Enhanced Cellular Networks System Model

We consider a downlink relay enhanced cellular network consisting of seven cells in this paper, as shown in Figure 1. The hot cell is in the center, surrounded by other six cooler cells. Each base station (BS) locates at the center of the cell. Each relay station (RS) is placed at the shared border of two adjacent cells, and can associate with only one of them. Each RS work in half duplex mode. It receives data from BS in the first time-slot, then decodes and forwards (DF) the data to MSs in the second time-slot. The BS and all the RSs associated to it share all the spectrum resources. Considering that locations of RSs are fixed and can be designed, we assume that there exist line-of-sight channels between a RS and its adjacent BSs. A RS utilizes special directional antennas to communicate with its two adjacent BSs, and can handover between them. All the MSs distributed uniformly in each cell are divided into two parts, one is called direct link users who communicate with the BS directly, the other is called relay link users who communicate with the BS via a relay using two hops.

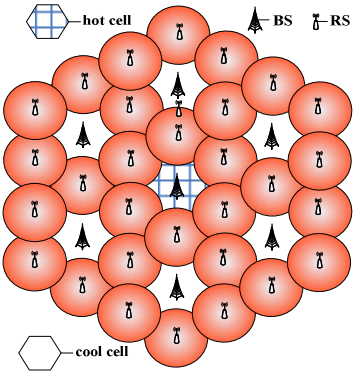

Fig. 1. System Scenario

2.2 Load Balancing Problem Description

In this paper, ψ_{Bs} denotes the set of BSs and ψ_R is the set of relays. The spectrum resource is divided into M subchannels in each cell. The set of RT users is denoted by φ_{rtUser}, and each user's data rate is R_{rt}; $\varphi_{nrtUser}$ means the set of NRT users, and each user's data rate is variable between the minimal value $R_{nrt}^{\min}$ and the maximal value $R_{nrt}^{\max}$; w is the bandwidth of each subchannel; p_{Bs} and p_R separately denotes the transmission power of BSs and RSs on each subchannel. In this system, we only consider Path Loss (PL) as the channel gain.

As RSs work in DF mode, one relay link user's data rate is determined by the minimal channel gain of BS-RS link and RS-MS link. The channel condition of BS-RS link is perfect as that RSs use special directional antennas to communicate with their adjacent BSs. Therefore the channel gain of RS-Ms link determines the relay link user's data rate. We denote the instantaneous data rate of each subchannel between MS k and RS m as r_k^m:

$$r_k^m = \begin{cases} \frac{w}{2}\log_2\left(1+\frac{p_R l_k^m}{N_0 w}\right), & l_k^m > Th \\ 0 \qquad\qquad\qquad\quad , & l_k^m \le Th \end{cases} \tag{1}$$

where l_k^m denotes the channel gain between MS k and RS m, Th is the threshold of the signal to noise rate (SNR) that MS k can decode its data successfully.

Direct link users can receive data from a BS all the time. Thus the data rate between MS k and BS n can be written as:

$$r_k^n = \begin{cases} w\log_2\left(1+\frac{p_R l_k^n}{N_0 w}\right), & l_k^m > Th \\ 0 \qquad\qquad\qquad\quad , & l_k^m \le Th \end{cases} \tag{2}$$

where l_k^n is the channel gain between MS k and BS n.

BS is supposed to be a special RS for the purpose of utilizing the same expression, so that we assume $\psi_{Bs} \subset \psi_R$ in this paper. The needed subchannel number of the RT MS k from RS m can be given by:

$$N_{rt,k}^m = \begin{cases} \left\lceil \frac{R_{rt}}{r_k^m} \right\rceil, & r_k^m \neq 0 \\ MAX, & r_k^m = 0 \end{cases} \tag{3}$$

where $\lceil x \rceil$ denotes the minimal integer that is not less than x, and $MAX >> M$.

The minimal needed subchannel number of NRT MS k from RS m is $N_{nrt,k}^{\min,m}$, and the maximal value is $N_{nrt,k}^{\max,m}$. They can be written as:

$$\begin{cases} N_{nrt,k}^{\min,m} = \left\lceil \dfrac{R_{nrt}^{\min}}{r_k^m} \right\rceil \\ N_{nrt,k}^{\max,m} = \left\lceil \dfrac{R_{nrt}^{\max}}{r_k^m} \right\rceil \end{cases} \tag{4}$$

In the relay enhanced cellular network, we can control the associations of RSs to BSs and the associations of MSs to RSs dynamically. Also, we can decrease the allocated channel number of NRT users to allow more MSs to be served. The optimization problem can be formulated as follows:

$$\max\left(\frac{\sum_{k\in\phi_r} \varepsilon_k}{N_{\phi_r}} \right) \tag{5}$$

s.t.

$$a) \quad \sum_{k\in\phi_r} \sum_{m\in\psi_R^n} \varepsilon_k \rho_m^n \beta_k^m n_k^m + \sum_{k\in\phi_a} \sum_{m\in\psi_R^n} \rho_m^n \beta_k^m n_k^m \le M, \quad \forall n \in \psi_{Bs}$$

$$b) \quad \varepsilon_k \in \{0,1\}, \quad \forall k \in \phi_r$$

where ϕ_r denotes the set of MSs with access request; ϕ_a denotes MSs which have accessed successfully; N_{ϕ_r} is the number of access request MSs; $\varepsilon_k = 1$ means that MS k is allowed to access into the network, otherwise $\varepsilon_k = 0$; ψ_R^n denotes the set of seven relays that surround BS n (BS n is a special RS); n_k^m denotes the number of allocated channels for RS m-MS k pair; if MS k connects to RS m, then $\beta_k^m = 1$,otherwise $\beta_k^m = 0$; $\rho_m^n = 1$ means that RS m connects to BS n, otherwise $\rho_m^n = 0$.

In(5), the optimal object is to maximize the accepted users to all request ones rate. Constraint $a)$ means that the total number of channels allocated to the users in cell n should be no more than M. The variable in (5) must satify the following constraints:

$$\begin{aligned} &c) \quad \rho_m^n, \beta_k^m \in \{0,1\}, \forall k, m, \forall n \notin \psi_{Bs} \\ &d) \quad \rho_m^n = 1, \forall (m = n) \in \psi_{Bs} \\ &e) \quad \sum_{n\in\psi_{Bs}} \rho_m^n = 1, \forall m \\ &f) \quad \sum_{m\in\psi_R} \beta_k^m = 1, \forall k \\ &g) \quad n_k^m = N_{rt,k}^m, \forall m, \forall k \in \varphi_{rtUser} \\ &h) \quad N_{nrt,k}^{\min,m} \le n_k^m \le N_{nrt,k}^{\max,m}, \forall m, \forall k \in \varphi_{nrtUser} \end{aligned} \tag{6}$$

In(6), d) means the special RS can only associate to itself; e) means a RS can only associate to one BS; f) means one MS only can associate to one RS; g) and h) mean that the number of channels allocated to RT users is a constant, but it is a variable for NRT users.

We can conclude that the optimization problem is NP-hard from (5)and(6), therefore, we will present a heuristic strategy with low complexity in the next section.

3 Load Balancing Strategy

In this section, a heuristic load balancing strategy is proposed. The process of the proposed strategy mainly contains the cell selection, the decreasing number of subchannels allocated to NRT MSs, the handover of MSs and the handover of RSs steps, as shown in Fig. 2. We will deal with RT MSs first when several users send access requests at the same time, and process in the ascending order of needed subchannel number among the same kind of users. The detailed procedure is as follow:

Step 1: cell selection
In the first step, a MS will choose a cool cell to access via a RS. First, the MS chooses a cell in which the least subchannels are needed. If the unused subchannels of this cell are sufficient, the MS will access the cell, otherwise, the MS will select the adjacent cell. If the adjacent cell doesn't have sufficient resources or the MS locates at the center area of cell, we will go to step 2.

Step 2: decreasing the number of subchannels allocated to NRT MSs
Since the data transmission rate of NRT MSs is adjustable, the BS could decrease the subchannels allocated to NRT MSs if the number of subchannels owned by these MSs are more than the minimal value. To achieve fairness, the BS decreases the number of their allocated subchannels by one every time until the released resource can satisfy the access request of MS or there are no adjustable MSs. If all the subchannles of NRT MSs have been adjusted to the minimum value, while the idle resource is still not enough, then we will go to step 3.

Step 3: handover of MSs
We use n_i^1 and n_i^2 to separately denote the needed number of subchannels of MS i in the server cell and target cell. N_{idle}^t and N_{var}^t mean the number of idle subchannels and adjustable subchannels. In this step, for the purpose of adjusting subchannels, the BS will let the MSs in overlapped areas handover to adjacent cooler cells. The handover

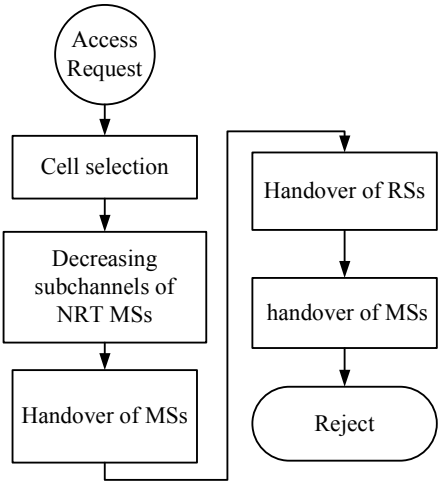

Fig. 2. Process of the Load Balancing Strategy

is executed in ascending order of $(n_i^2 - n_i^1)$. The handover process of a MS is successful only when the following condition is satisfied:

$$n_i^2 \le N_{idle}^t + N_{\text{var}}^t \tag{7}$$

If all the MSs who satisfy (7) have been trasferred to the adjacent cells, but the released resource is still not enough, then we will go to step 4.

Step 4: handover of RSs
In this step, the BS will transfer RSs and MSs associated to the RS together to the adjacent cooler cells. The handover process of a RS is successful only when it satisfies:

$$\sum_{i \in \phi_a^r} n_i^1 \le N_{idle}^t + N_{\text{var}}^t \tag{8}$$

where ϕ_a^r denotes the set of MSs under RS *r*. If all the RSs who satisfy (8) have been transferred, but the released subchannels are still not enough, then we will go to step 5.

Step 5: another handover of MSs
Due to the handover of RSs, the overlapped areas of the cell have changed, so there may be some new MSs can be successfully transferred to adjacent cooler cells. The BS will execute step 3 again. After executing this step, if the released subchannels are still not enough, the MS with access request will be rejected.

Finally, after all MSs with access request have been dealed with, the BS will allocate the left subchannels to the accessed NRT MSs whose number of allocated subchannels has not reached the maximal value. It is for the purpose of improving the spectrum efficiency.

4 Simulation Result

In the simulation, the Path Loss model is:

$$PL = 36.7\log_{10}(d) + 22.7 + 26\log_{10}(f_c) \tag{9}$$

where the unit of d is km, the unit of f_c is GHz.

In the downlink relay enhanced cellular network, MSs distribute uniformly in each cell. The number of RT MSs and NRT MSs are equal. Each MS randomly switches between two different states: idle and active. Both the idle and active time follow negative exponential distribution, whose mean value is 30 slots. The simulation has been performed for 20 times, and each time contains 1000 slots. The detail simulation parameters are shown in Tab.1.

Table 1. Simulation Parameters

Parameters	Value
Radius of BSs	1km
Radius of RSs	0.5km
Number of subchannels *M*	256
Bandwidth of subchannels *w*	10kHz
Number of MSs in cool cell	50
Rate request of RT MSs R_{rt}	100kbits/s
Rate request of NRT MSs $R_{nrt}^{\min}$	250kbits/s
Rate request of NRT MSs $R_{nrt}^{\max}$	500kbits/s
Threshold of the received SNR	0dB
Power of BSs	8.7dBm/subchannel
Power of RSs	-5.9dBm/subchannel
Power of noise	-174dBm/Hz
Central frequency f_c	2.4GHz

In Fig. 3, we can see the new call blocking probability of four cases. The network with relays and the proposed load balancing (LB) strategy has the best performance.This is because each step in the proposed strategy is for the purpose that more MSs can access the network. Step 1, 3, 4 and 5 are able to transfer more traffic from hot cell to cooler ones. Step 2 is able to allow more MSs to be accepted through releasing subchannels of NRT MSs.

In Fig. 4, we compare the new call blocking of RT MSs, NRT MSs and all MSs. Since the RT MSs have the higher priority, we treat them first. When the load becomes heavier, the gap between NRT MSs and RT MSs become larger. The result demonstrates that we guarantee the high priority of RT MSs.

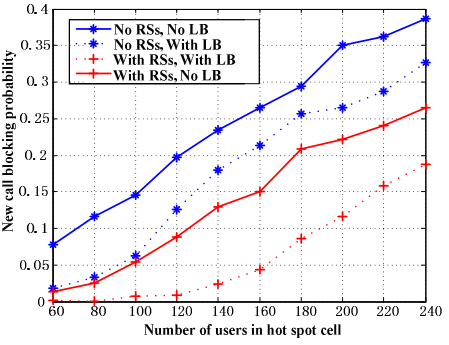

Fig. 3. Comparison of New Call blocking Probability

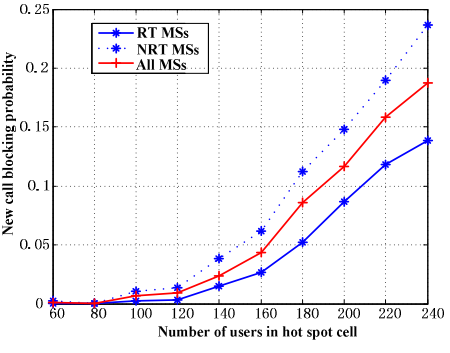

Fig. 4. Comparison between Different Kinds of Users

5 Conclusion

In this paper, we formulate the load balancing problem as an optimization problem first, and then we propose a five-step strategy to solve the problem. We utilize the cell selection, the decreasing NRT MSs' subchannels, the handover of MSs and RSs to release subchannels of hot cell as many as possible. Thus it can allow more MSs to access the network. The simulation results demonstrate the view above.

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An Approach for News Web-Pages Content Extraction Using Densitometric Features

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Abstract. This paper mainly studied and implemented an approach for content information extraction of news web-pages using the density features. The method firstly parses and partitions the HTML documents into textual blocks, then calculates the value of their specific density features, and finally uses C4.5 decision tree algorithm to construct a classification model of textual blocks. With the classifier, the content information of web pages can be easily and properly extracted by identifying their content textual blocks. The experiments show that it is a simple and effective approach for extracting content information from news web-pages and has a certain practicality.

Keywords: Densitometric features, content analysis, content extraction, information processing, web page.

1 Introduction

With the rapid development of Internet, World Wide Web has been the main medium for global information. However, too many web pages contain a large amount of less informative and typically unrelated material such as navigation menus, user comments, advertising information and irrelevant links so that it has a serious impact on extracting valuable information from the web pages. Therefore, it has become increasingly important to extract content information from web pages accurately and effectively.

A lot of research work about content extraction has been carried out in recent years, and their basic procedures is as follow: firstly segment web pages by various rules, then annotate the segments with features, at last extract the content information by filtering the noisy segments. Therefore content extraction is related to web page segmentation. DOM tree is one of the most extensively used methods. Kohlschutter et al. present a statistical model for the distribution of segment-level text densities, and use the text density ratios of subsequent blocks to identify page-level segments [1]. Deng Cai et al. use the vision-based features to solve the problem of web page segmentation [2]. There are many studies on the web page features used to filter the noisy information. Some researchers utilize several text features of density to process the noisy tree nodes of web page DOM tree and extract the web content information

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[3-4]. ZHOU Jiaying et al. present a content extracting method base on statistic and content features [5]. ZHANG Xia-liang et al. propose that takes the logic lines as the basic process units and using maximum admitting distances to decide the final contents of web pages [6]. Pasternack et al introduce maximum subsequence segmentation, a method of global optimization over token-level local classifiers, mainly focusing on extracting the main content in the domain of news websites [7].

On the basis of analysis and experiments with a large number of web pages, this paper utilize text density and link density to simplify the presentation of the densitometric features of text blocks, then use these two features for C4.5 decision tree algorithm to construct a classification model of textual blocks and identify the content textual blocks of web pages through the model, finally combine the content textual blocks to get the content information of web pages. The result of analysis and experimentation shows that this method is feasible and practical.

2 Content Extraction Using Density Features

2.1 Analysis of the Density Features

Web page features can be extracted varies in different levels. This paper takes the text blocks as the basic process units. Text blocks are sequences of text that is not interrupted by any HTML tags, except for A tags. One or more such text blocks can combine into a text block too, and then a web page can be simply substituted by a series of several or more text blocks.

1) The link density of text block

As we know, there is little chance of taking a text block as a content textual block if the length of text within an A tag is longer enough. So the ratio of the total length of text in A tags to the length of text in a text block is strongly related to its type identification. The text block's link density can be formulated as follows:

$$LD(b_i) = \frac{total\ length\ of\ texts\ within\ all\ A\ tags\ in\ b_i}{length\ of\ text\ in\ b_i} \tag{1}$$

2) The text density of text block

Besides the link density measure, we also evaluate the text density of each text block. It is obvious that the content textual blocks contain much more text information than those non-content textual blocks contain, and the length of the blocks can be used to distinguish whether they are content textual blocks or not. In this paper, we substitute the text length by text density. Text density is a ratio between the length of text in a block and the number of lines in a block. Assume that every web page has a same fixed column width $W_{\max}$, and then the number of lines in the text block b_i ($L(b_i)$) and its text density ($TD(b_i)$) can be calculated as follow:

$$L(b_i) = \left\lceil \frac{Length\ of\ text\ in\ b_i}{W_{\max}} \right\rceil \tag{2}$$

$$TD(b_i) = \frac{Length\ of\ \ text\ in\ b_i}{W_{\max} * L(b_i)} \tag{3}$$

Through the above analysis, we know that the two features have a strong correspondence to the type identification for text blocks to some extent.

2.2 Classification Experiments

Web page features can be extracted varies in different levels. This paper takes the text blocks as the basic process units. Text blocks are sequences of text that is not interrupted by any HTML tags, except for A tags. One or more such text blocks can combine into a text block too, and then a web page can be simply substituted by a series of several or more text blocks.

1) News web-pages collection and segmentation

In order to construct a practical and applicative classification model, we produced a news web-pages data set which was obtained from different news web sites and various news topics. With the help of Heritrix(an internet archive's web crawler, which was specially designed for web archiving), thousands of news web pages were gathered from several mainstream media in China, finally three hundred news pages were picked arbitrarily as training examples among several best known news sites such as news.163.com, news.ifeng.com, news.sohu.com, news.people.com.cn xinhuanet.com, news.qq.com and so on.

The text density features approach investigated require the training web pages to be segmented into text blocks, which were then calculated with the densitometric features we have mentioned above. In this paper, the NekoHTML parser (a simple HTML scanner and tag balancer that enables application programmers to parse HTML documents and access the information using standard XML interfaces) is used for simply and reliably implementing the segmentation of the training web pages to minimize the expected cost, and then the density characteristics of each text block were calculated by definition. At last, all text blocks were simply labeled as “Content textual block” or “Non-content textual block” by hand and the statistical data of class distribution in the training web-pages data set as shown in Table 1.

Table 1. Class-Distribution in the Training DataSet

	# Blocks	**#Characters**
Content textual block (Y)	6.8%	38%
Non-content textual block (N)	93.2%	62%

2) Classification model training

As we can see that there is a greater chance that a text block is a content text block when its adjacent blocks were identified as content text blocks, so the two density features of current text block, its predecessor and successor were used to train the decision tree classifier. This paper takes analytic experiments of C4.5-based decision

tree classifiers on the platform of Weka. In order to avoid over fitting, the algorithm has been configured to only consider leaves matching at least 100 instances and set the confidence factor as 0.25, by starts the classification, we can get a classifier model(the size of the decision tree with 13 leaves is 25) as shown in Fig. 1.

```
C_TEXT_DENSITY <= 0.475
|   P_TEXT_DENSITY <= 0.475
|   |   C_LINK_DENSITY <= 0.454545
|   |   |   C_TEXT_DENSITY <= 0.125: N (3084.0/60.0)
|   |   |   C_TEXT_DENSITY > 0.125
|   |   |   |   N_LINK_DENSITY <= 0.642857
|   |   |   |   |   N_LINK_DENSITY <= 0.294118
|   |   |   |   |   |   N_TEXT_DENSITY <= 0.075: N (131.0/12.0)
|   |   |   |   |   |   N_TEXT_DENSITY > 0.075: Y (176.0/85.0)
|   |   |   |   |   N_LINK_DENSITY > 0.294118: Y (104.0/9.0)
|   |   |   |   N_LINK_DENSITY > 0.642857: N (139.0/10.0)
|   |   C_LINK_DENSITY > 0.454545: N (17280.0)
|   P_TEXT_DENSITY > 0.475
|   |   C_LINK_DENSITY <= 0.363636
|   |   |   P_TEXT_DENSITY <= 0.5875: N (118.0/32.0)
|   |   |   P_TEXT_DENSITY > 0.5875: Y (175.0/35.0)
|   |   C_LINK_DENSITY > 0.363636: N (129.0)
C_TEXT_DENSITY > 0.475
|   C_LINK_DENSITY <= 0.075
|   |   N_TEXT_DENSITY <= 0.15
|   |   |   P_TEXT_DENSITY <= 0.225: N (125.0/15.0)
|   |   |   P_TEXT_DENSITY > 0.225: Y (129.0/21.0)
|   |   N_TEXT_DENSITY > 0.15: Y (989.0/2.0)
|   C_LINK_DENSITY > 0.075: N (207.0/1.0)
```

Fig. 1. Classifier model for the Training DataSet

2.3 Evaluation and Analysis of Classification Model

In order to measure the accuracy of the classifier model, we used a 10-fold cross validation method to validate the model, by using Weka, we can get the detailed accuracy by class and its confusion matrix as shown in Fig. 2, Fig. 3.

```
    a     b   <-- classified as
21083   152 |     a = N
  160  1391 |     b = Y
```

Fig. 2. Confusion Matrix

As we see from Fig. 3, the classifier model got a remarkable accuracy with the precision, recall, FP rate and ROC Area. The confusion matrix shows that the number of the text blocks which were correctly classified reach up to 22474, and the percentage is 98.63%. There are still 160 content text blocks were incorrectly classified as non-content text blocks, and the mass of experiments testify the exceptions were occur in extracting the news web pages which contains short texts.

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.993	0.103	0.992	0.993	0.993	0.993	N
	0.897	0.007	0.901	0.897	0.899	0.993	Y
Weighted Avg.	0.986	0.097	0.986	0.986	0.986	0.993	

Fig. 3. Detailed Accuracy By Class

In practical application, some good heuristic strategies were used to achieve a more remarkable accuracy after the text blocks were classified by the classifier model. For instance, if the predecessor and successor of the block are identified as content text blocks, the block would be identified as a content text block too. By using these good heuristic methods, the system would achieve a more perfect accuracy.

3 Conclusion

Content extraction plays a quite important role in the information retrieval application, and the accuracy of the content-based applications can be increased significantly through the rapid and efficient content extraction methods. This paper mainly studied and implemented a simple and yet effective method and the extensive experimentation show that the method has a good performance for extracting content information from news web pages. Meanwhile, it has some applicability and portability to some extent, and can be suitable for some specific fields more accurate by training web pages data sets in their relative fields.

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An Investigation of Experimental Teaching Platform Based on WEBQUEST – A Case Study in the Network Engineering

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Abstract. This paper, according to that network engineering courses is spanning space-time, autonomous and collaborative teaching requirements, recurring to blended learning theory, comes up with network's experimental teaching platform based on WEBQUEST. This platform aims to resolve the limitation of traditional teaching methods, and integrate face-to-face teaching with online learning effectively, enhances the learners' chance and participation.

Keywords: WEBQUEST, blended theory, network, collaborative, teaching platform.

1 Introduction

Currently, various trades and industries, including government, military, scientific research institutions, community, enterprises and other organizations, have a rapid increasing demand of the qualified experts on all aspects of network technology. How do the colleges and universities adapt to the times' demand, now, this is a urgent and important strategic mission. The traditional teaching, due to its limitation of teaching scale, is not in the interest of cultivating the students' personality and embodying students' main body, so in this time web 2.0, How to fully embody the active participation of learning web-based, make best of teachers' advantages on leading function, personality effect, study and research methods, and implement teacher-to-student, student-to student cooperation and communication, has been a common topic focused by people.

The teaching method of network exploring occurs at the right time because of such requirement. For web is network and quest is the question exploring, webquest is a learning process by using network resources to explore. It consists six parts: introduction, task, resources, process, evaluation and conclusion. Each part can be a separate a unit. Teachers can direct the students' learning process by designing and describe these six parts.

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This article puts the teaching method of webquest into network engineering courses and reaches the goal that meet the demand of engineering network intelligent by combining them effectively.

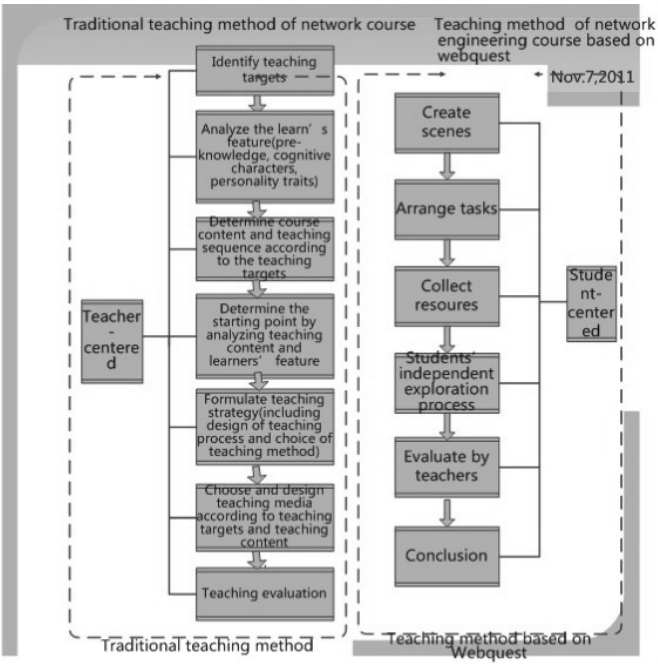
Traditional teaching method of network course
Teaching method of network engineering course based on webquest
Nov.7,2011
Identify teaching targets
Analyze the learn' s feature(pre-knowledge, cognitive characters, personality traits)
Determine course content and teaching sequence according to the teaching targets
Determine the starting point by analyzing teaching content and learners' feature
Formulate teaching strategy(including design of teaching process and choice of teaching method)
Choose and design teaching media according to teaching targets and teaching content
Teaching evaluation
Teacher - centered
Traditional teaching method
Create scenes
Arrange tasks
Collect resoures
Students' independent exploration process
Evaluate by teachers
Conclusion
Stude nt-center ed
Teaching method based on Webquest

Fig. 1. The different of two methods

2 WebQuest Teaching Platform for Network Engineering Courses

University of network engineering talent cultivation should have the following capacities:

- Network foundation ability
- Mastery ability
- network design, planning experience
- network configuration experience
- practical ability

The picture below is the constitute module of Network engineering courses WebQuest teaching platform. This module were five parts, respectively is experimental scene, online stents, resources cooperation mode, interactive platform inquiry and scene training. One online stents, resources cooperation mode can be called the Web of WebQuest, and interactive platform explore the corresponding Quest, this is part of the five parts cultivate emphatically the six ability:

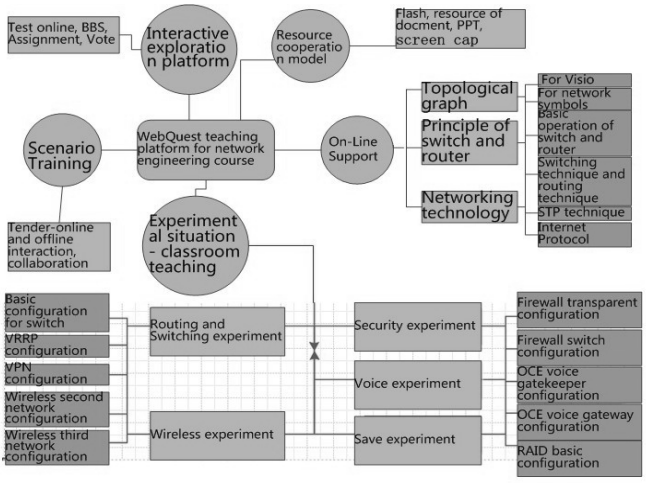

Fig. 2. The constitute module of Network engineering courses WebQuest teaching platform

2.1 Introduction Teaching

Network engineering course has a strong practicality, therefore, real classroom teaching environment is indispensable. Network engineering course of experiment teaching system requires both engineering training, and need for training scene perception of true knowledge and skills. Vivid video can effectively stimulating connect in the mind, arousing the knowledge and experience or long-term memory, which let learners can use the related knowledge and experience. Then in the original cognition structure absorb they are learning new knowledge, and give the new knowledge of certain significance. If the original knowledge and experience can't assimilate new knowledge, authentication procedures should be aroused. That is to say, reconstruct and restructure the original cognitive structure. Teachers should seriously analyze the learner's perception, memory, thinking, motivation, experience and emotional or other factors, in order to find the juncture between cognitive structure and study content. Also they can use a suitable for students' cognitive psychology external boost to assimilation process and complete the significance of constructing new knowledge to improve the students' intelligence development level enhancement. Only then can let learners achieve meaning construction. In this network engineering course, experiment mainly have five categories: routing exchange experiments, safe experiment, the experimental phonetics, storage experiments and wireless experiment. Every kind of experimental requires that it should be finished in a real environment.

Wherever Times is specified, Times Roman or Times New Roman may be used. If neither is available on your word processor, please use the font closest in appearance to Times. Avoid using bit-mapped fonts if possible. True-Type 1 or Open Type fonts are preferred. Please embed symbol fonts, as well, for math, etc.

2.2 WEB

The web provides some background materials, which arouse students' prior knowledge experience, to prepare the teaching design for the new learning .For example, according to demand draw topology graph, switch, routers using and networking technical control, etc.

This material can be dependent on resource WebQuest teaching platform, including network engineering courses in all kinds of material.

PPT: Includes five kinds of network engineering courses teaching purpose and teaching contents, and teaching steps in detail.

Screen cap: make video screens for major experiments, such as switches basic VPN configuration, firewall configuration, transparent configuration, etc. The students of class can preview and review to study the knowledge, and this form is clear and straightforward.

Video-on-demand and document-on-demand: make all kinds of upload network engineering course material conversion become FLV format, to realize the online demand, convenient and fast.

Test: used for students to learn the knowledge that was detected.

Reference information links: Reference message of course content learning is of help. The teacher may guide the student to read relevant references or use the related resources of learning in order to facilitate learners can carry out creative learning and finish the assignments under the cognitive environment.

2.3 Quest

Because of the complexity of knowledge and in some cases the difficulty of solving problems, it is necessary to carry out the network teaching inquiry. In this inquiry learning environment, team-mates can share all thoughts and wisdom, namely the whole learning group focused completed their meaning construction for knowledge.

In the learners and teachers of inquiry, learners can get teacher's instruction, at the same time, teachers can obtain student feedback information. Cooperation can undertake between two or more students. Through teacher's guidance, face-to-face exchanges directly or an Internet thought BBS, can undertake collaboration. In collaboration and exploration, through the same problem but different point of comparison and analysis, learners can ascend oneself, abundant understanding of knowledge, improve the structure adjustment process to the various points significance construction ability. Therefore, exploring environmental creation should be considered in the design of considering the design of network teaching platform.

If teachers want to know the students' attitude to a question, such as in the VPN configuration experiment, teachers find which way of configuration the students prefer to by voting. The teachers set content and voting items, and then students can participate in the vote.

BBS is a multiplayer collaboration tools, which can be maintained by lots of people, and each person can express his (her) own opinions, or on a common topics extend or discussion. Teachers and students can discuss about the communication configuration among single-arm routing Vlan, including the configuration of the steps,

the problems, etc. BBS support oriented communities of collaborating writing, which can help users in a Shared a certain area within the community of knowledge.

Test, there can add a different type of problem. The system defaults each class total includes 10 children, including multiple-choice, topic fills up the topic, digital topic, the judge topic, the matching problem, fills up the topic, the matching parentheses, random title, description and math. After the edit of test being completed, click edit test, the students can be carried on online testing.

2.4 Introduction Training – Tender as an Example

This part is according to normal tender of the standard to require students, and to find a real case, according to the bidding WebQuest six module teaching. Specific steps pursues as follows:

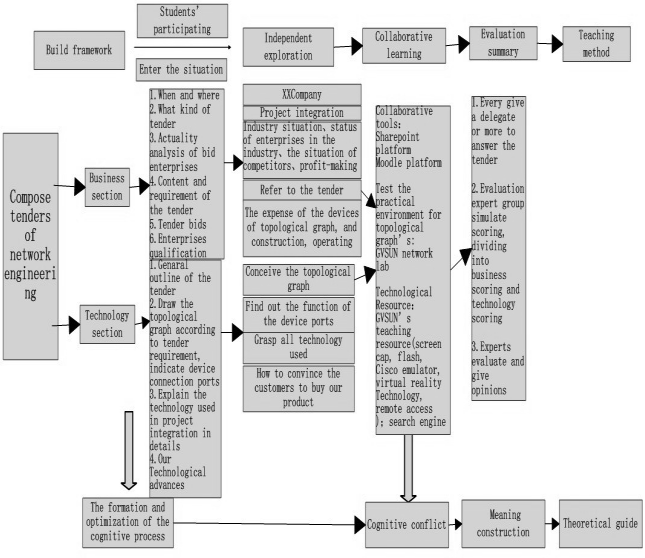
Build framework
Students' participating
Enter the situation
Independent exploration
Collaborative learning
Evaluation summary
Teaching method
Compose tenders of network engineering
Business section
Technology section
1.When and where
2.What kind of tender
3.Actuality analysis of bid enterprises
4.Content and requirement of the tender
5.Tender bids
6.Enterprises qualification
1.General outline of the tender
2.Draw the topological graph according to tender requirement, indicate device connection ports
3.Explain the technology used in project integration in details
4.Our Technological advances
XXCompany
Project integration
Industry situation、status of enterprises in the industry、the situation of competitors、profit-making
Refer to the tender
The expense of the devices of topological graph, and construction, operating
Conceive the topological graph
Find out the function of the device ports
Grasp all technology used
How to convince the customers to buy our product
Collaborative tools:
Sharepoint platform
Moodle platform
Test the practical environment for topological graph's:
EVSUN network lab
Technological Resource:
EVSUN's teaching resource(screen cap, flash, Cisco emulator, virtual reality Technology, remote access); search engine
1.Every give a delegate or more to answer the tender
2.Evaluation expert group simulate scoring, dividing into business scoring and technology scoring
3.Experts evaluate and give opinions
The formation and optimization of the cognitive process
Cognitive conflict
Meaning construction
Theoretical guide

Fig. 3. A real case use in teaching

This tender is aimed at a true bid project, a hospital network transformation, It need student group, the first thing is to let students enter scene, to analysis tendering time, place, content, company of qualification, technical part. And then students according to their own tasks carry out independent exploration. The independent exploration stage could ask help from WEB. Next share and cooperatively learn independent exploration achievements. The last stage is to each group's results are evaluated.

3 Conclusion

Through WebQuest teaching platform for learning, the student can study in classrooms, then review and exercises learning online at distance. Also can choose

take lectures in classroom or online watch a period teaching video. The biggest advantage lies in practice learning between teachers and students, students and students.

Aiming at WebQuest teaching method, this paper made an investigation and study with 30 people.

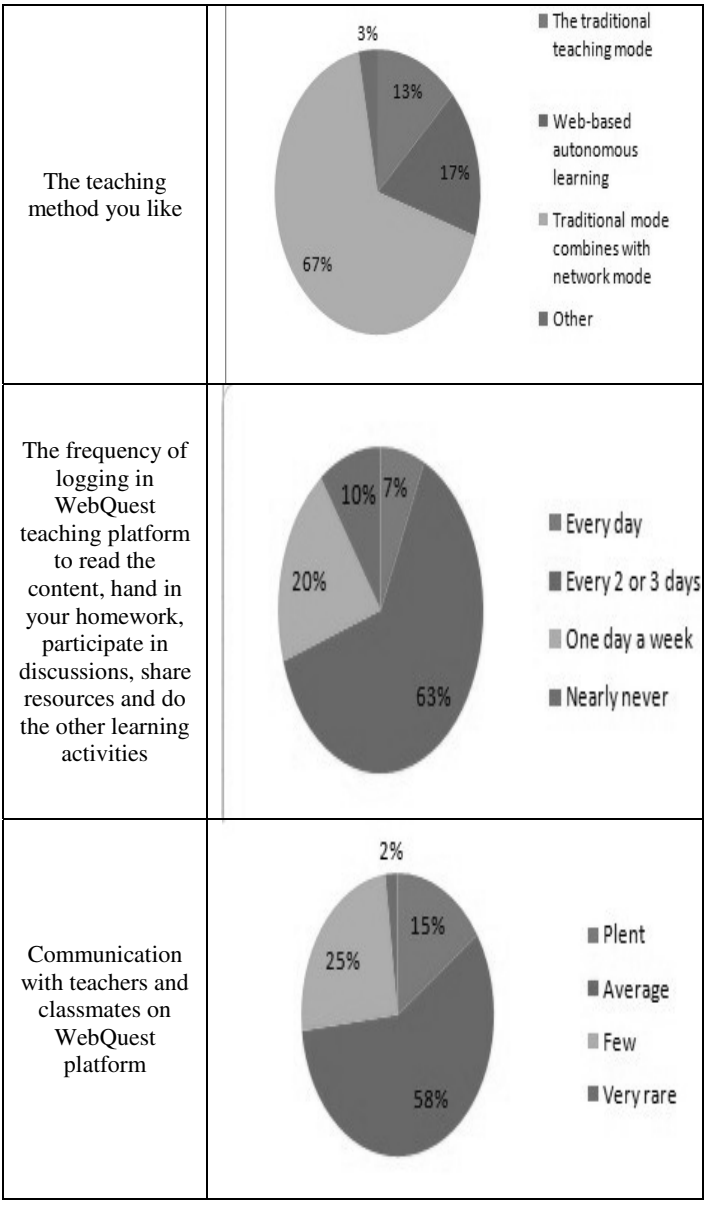

Fig. 4. An investigation for WebQuest teaching method

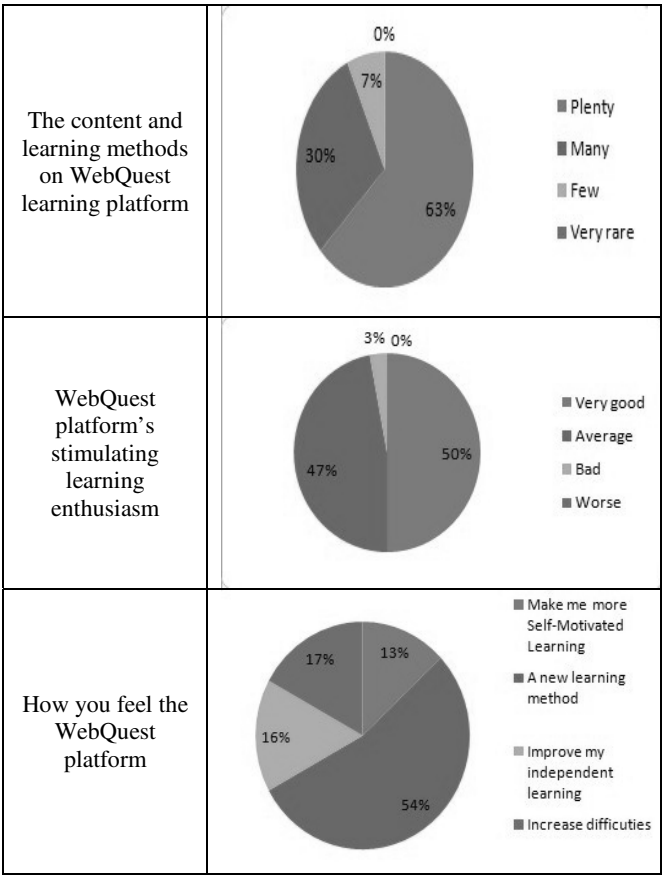

Fig. 4. (*continued*)

By questionnaire we can see: WebQuest provide more opportunities for communication for teachers and schoolmates. Teachers can communicate with schoolmates in classroom also can be in online BBS, or post messages by curriculum chat room. Compare this with simple online learning and pure face-to-face teaching all has more advantage. In simple online learning, because of distance questions learners will have a strong feeling of loneliness, unfavorable to exchange. In simple face-to-face teaching, due to the limiting of time, learners in the classroom do not have enough time and opportunity to fully thinking and communication.

1) Hybrid course still can more easily invite experts for remote participation. Visiting experts through the network can directly involve in the curriculum activities. These experts maybe in a certain area than the course teachers who have a higher level can give students more inspiration.

2) Learners have more opportunities to rethink the knowledge. Blended learning provides all possible learning opportunities to the learners. Except in the classroom knowledge construction and communication , learners can reorganize and reflect

what have studied after class by the Internet on what they have learned and can also with other learners common reflection, collaboration construct knowledge.

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Study the Ways to Evaluation and Classification of Odor Pollution

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Abstract. In recent years, the numbers of odor pollution sources and odor pollution events are increasing rapidly, along with the high growth of life quality and the growing of people's environmental awareness. Odor pollution has been one of the hot and most difficult problems that nagging the environmental management department. Evaluate and classify to odor pollution is important basis for analyzing the odor pollution. This article discussed the classification of odor pollution preliminary.

Keywords: Odor, environment pollution, evaluation and classification formatting.

1 Introduction

In recent years, the numbers of odor pollution sources and odor pollution events are increasing rapidly, along with the high growth of economics and urbanization process. Odor pollution becomes a serious environmental and social problem, mainly attributable to various chemical industries, sewage disposal plants and garbage landfill sites, coupled with the unreasonable urban planning and industry layout. However, it is difficult to reveal the rules of odor diffusion with dilution, because of the complexity of odor components and its widespread sources as well as other influencing factors (i.e. meteorology, landform, hypsography, etc.). Odor pollution has been one of the hot and most difficult problems that nagging the environmental management department. The control and management of odor pollution has aroused wide concern. Currently a number of universities, enterprises, scientific research units have carried out research in this area, however, the research team is still very weak.

2 The Essentiality of Quantitative Evaluation and Classification

According to warning situation analysis of odor pollution, accurately determining the influence of odor pollution and taking timely decisive and effective measures is the key to control odor pollution when odor pollution happens. Quantitative evaluation and classification of odor pollution is an important basis for the warning situation analysis of odor pollution. The odor pollution is often produced by a variety of malodorous compounds. The interaction between the various components of odor pollutants may

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have a role in stacking or reduction [1]. So we can never use the concentration of one or several pollutants to express the degree of odor pollution, and only be expressed with integrated indicator. The odor concentration and odor intensity are two common indicators of degree of the human sense stimulation to odor pollution. However, due to representation of odor intensity is a direct representation, we divided the degree of the human sense stimulation to odor pollution into several levels (such as 5 or 6), tested and measured the degree of the odor sample by the panelists distinguishing carefully, this can only do qualitative analysis, but not quantitative analysis to the odor pollution. Odor concentration is the integrated indicator to express the degree of the human sense stimulation to odor pollution in "Odor pollution emission standards", but not carry on the rank division to it.

3 The Method of Evaluating and Classifying

3.1 Establishment of Classify Method

According to a large number of studies, odor intensity and odor concentration is proportional to the logarithm. It can be expressed by Weber - Fechner formula. Weber - Fechner equation describes the relationship between the amount of external stimuli and the amount of people's feeling. We can regard odor concentration C as objective quantity of stimulus and regard odor intensity I as human's feeling, that is what we call the relationship between odor concentration and odor intensity:

$$I = K \lg C \tag{1}$$

To look for the rule of this relationship further, we can differentiate to equation (1) and we have the equation (2):

$$\Delta I = K \frac{\Delta C}{C} \tag{2}$$

The equation (2) shows that when the olfactory stimulus of malodorous substance to human changes by geometric proportion, the people's feeling changes by gradation of difference [2]. Therefore, when we classify odor concentration, concentration limits of every grade changes by geometric proportion, but the people's feeling changes by gradation of difference. At present, our country uses six intensity representation, the change of intensity level can be regarded as the equal difference change. Accordingly, in accordance with the rule of Weber - Fechner formula, we divide the range from background value of odor concentration C_{in} in the environment to upper limit value C_{id} which influences people's life hardly into six grades(where k =0,1,2,3,4,5)in the light of the rule of geometric proportion. Where i = 0 and i = 5 corresponds to C_{in} and C_{id} respectively, so k = 0,1,2,3,4,5 corresponds to the level i = 0,1,2,3,4,5, respectively. Clearly, the objective importance ratio of the odor concentration at any two levels (between i and m) should be as follow:

$$\frac{C_i}{C_m} = K^{i-m} \text{ (where } i,m=0、1、2、3、4、5) \tag{3}$$

When m=0, the equation (3) as:

$$C_i = C_{in} K^{i-m} \tag{4}$$

When i=5, m=0, the equation (3) as:

$$K = \left(\frac{C_{id}}{C_{in}} \right)^{\frac{1}{5}} \tag{5}$$

Inside, K is the ratio of person's feeling quantity between consecutive odor concentrations.

3.2 Classification

According to the "Odor pollution emission standards", when the odor concentration C_{in} = 10 in environmental, the I level environmental is perfect. And when C_{id} =600, it influences people's life badly as a matter of experience. Then we can obtain the Table 1, which shows the comparison of odor intensity and odor concentration.

Table 1. Comparison of Odor intensity and Odor Density

No.	*Odor Intensity*	*Odor Concentration*	*Sense of Olfaction*
0	0	10	Odorless
1	1	23	Slight odor, but not distinguish scent
2	2	51	May distinguish scent
3	3	117	Can smell odor clearly
4	4	265	Strong odor
5	5	600	Very strong, make people feel nausea

As the relationship between the odor intensity and the odor concentration relationship, when the odor concentration rises by twice, the amount of people's feeling does not increase double; on the other hand, even if the odor concentration reduces by 97%, the human sense of smell only reduces by 50%. Therefore, the odor concentration in a small range of fluctuation will not affect our sense of smell. Based on the classification of Weber - Fechner expanding formula and olfaction sense of odor intensity, the classification of odor pollution as Table 2:

Table 2. The Grade of Odor Pollution Degree

Grade	*Odor Intensity*	*Odor Concentration*	*Pollution Degree*
Ⅰ	0	0-10	Odorless
Ⅱ	0-3	10-100	Primary Pollution
Ⅲ	3-4	100-300	Medium Pollution
Ⅳ	4-5	300-600	Strong Pollution
Ⅴ	≥5	≥600	Serious Pollution

4 Experimental Verification

The result of evaluation and classification to odor pollution is proved by experiments. This article chooses six people whose sense is normal to make six experiments. In each experiment, six panelists distinguish the same sample, and select the odor intensity, than test odor concentration for the sample with Triangle odor bag method (see experimental methods, "Air quality determination of odor bag method compared" GB/T14679-93). In these experiments, we need to test odor sample of distinct concentration respectively. The test result as described in Table 3. Experiments' results find that the test data and the gradation divide correspond to each other basically, but the fifth set of experimental results have a large biased errors, because of the different olfactory sensitivities of panelists to the different characteristic samples.

Table 3. Odor Pollution Degree Experiment Date

No.	*Odor Concentration*	*smell result*	*Pollution Level*
1	< 10	odorless	I
2	23	slight odor	II
3	51	slight odor	II
4	90	slight odor	II
5	160	smell odor clearly	III
6	200	smell odor clearly	III
7	280	smell odor clearly	III
8	300	Strong odor	IV
9	500	Strong odor	IV
10	800	Very strong	V

5 Conclusion

The warning situation analysis is space analysis for evaluation information of odor pollution with GIS technology to judge the level of odor pollution. Evaluation and classification of odor pollution is the important basis of analyzing odor pollution alert. In this paper, we calculate the corresponding odor intensity limits to the odor concentration through the relationship between odor intensity and odor concentration, than divide gradation for odor concentration according as experiment experience and sense of panelists. Quantitative evaluation and classification of odor pollution come true, and we verify the scientific and rational by experiments. The concepts of this method are of great importance to the odor pollution analysis. However, with the increasing of people's awareness to the environment, the odor pollution levels will be further graded intelligently.

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A Modeling Method of State Prediction for Algae Growth in Coastal Water*

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Abstract. The state of algae reproduction is a key index for the status of water quality for seashore and river. Algae growth is affected by many physical-chemical factors, this kind of complex relationship is difficult to be described by ordinary mechanism expression. Fuzzy BP model can describe the complex nonlinear system better, and can give a dynamic estimate to the output variables of the system. PCA(Principal Component Analysis) method can reduce the dimension of the sample data, simplify the complexity of the model system, meanwhile it can make the model has a faster convergence rate and a relative low dimension. The practical testing illustrates that fuzzy BP model based on PCA can be applied in state prediction for algae growth to good purpose.

Keywords: Principal component analysis (PCA), fuzzy BP network model, algae growth, state prediction, generalization.

1 Introduction

With economy developing and industrialization expanding continuously, the environmental pollution is increasingly serious. So rich in excessive emission of pollutants containing nitrogen and phosphorus continuously flow into the sea through the rivers, then the sea water becomes eutrophication, this brings on overgrowth of algae, and makes frequent outbreaks of red tide and other disasters. It will bring serious harm to the marine environment and surrounding people. Monitoring reproductive status of algae in coastal seawater dynamically can effectively know the changes of marine water quality and the emission status of pollutants to the sea from the rivers, it can predictive the disaster happening of outbreak of algae reproduction. We can build the early warning mechanism or take appropriate preventive measures to minimize the damage caused by disasters, also we can follow this to make a dynamic evaluation for the offshore environment, establish the overall development planning for the whole upriver and downriver area, make a sustainable development

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policy, regulate the industrial planning, reduce the environmental damage of extensive production.

A large number of studies show that the growth of algae is closely related to nitrate content, seawater temperature, salinity, oxygen solubility, light transparency, dozens of changes of physical-chemical factors [1],[2],[3]. The change of chlorophyll-a is the most direct indicator of seawater for algae content in seawater, which is also the integrated indicator to reflect the content of phytoplankton biomass [4],[5]. By analyzing the content of chlorophyll-a, we can know the status of phytoplankton biomass and the trend of its changing.

PCA(Principal Component Analysis) approach is formally proposed by Harold Hotelling in 1933, which is a statistical analysis methods to make the number of variables into a few principal components(or integrated variables) by the technique of dimension reduction.These main constituents can reflect the most information of the original variables, they are usually expressed as the linear combination of original variables. Currently PCA is an effective method to simplify the data structures and reduce the data dimension. In this paper, we researched the changing relationship between various physical-chemical factors and the algae concentration in seawater by the combining method of PCA and fuzzy BP networks, established the model of state prediction to predict the status of algae reproduction in coastal water.

2 Principal Component Analysis(PCA)

PCA can make the new variables: primary components (a linear combination of the original variables) convert to the variables which have no relationship each other by mathematical transform, several primary components which have more scale in variance information can be selected to analyze the object system, not only these primary components retain more information of all the original variables, but also they are not related each other. We can get the integrated variables that reflect the state of algae growth by weighted average of the cumulative size of the contribution rate of these primary components, and the large scale primary components got by comparing the total amount of information can be regarded as the input variables of the prediction model. The PCA method of the impact factors of algae growth can be implemented as follows:

Suppose the number of the impact factors is: n, the number of choice time that every factor can be chosen is: m, then the original data matrix is $X = (x_{ij})_{n\times m}$, thereinto, x_{ij} is the chosen value at number j times for the impact factor of number i, where $i = 1,2,\ldots,n$, $j = 1,2,\ldots,m$.

Step 1: Standardization processing for the data of impact factors. The input data is processed and normalized between 0 and 1:

$$X_s = \frac{(X_i - X_{\min})}{(X_{\max} - X_{\min})} \tag{1}$$

Where X_s is the value after normalized, X_i is the actual value which is not normalized, $X_{\min}$ and $X_{\max}$ are the minimum and maximum values of the variables respectively.

Step 2: Calculate the correlation coefficient matrix R of impact factors by using the standardized data:

$$R = (\frac{1}{(n-1)} \sum_{k=1}^{n} x_{ki}^{'} x_{kj}^{'})_{n \times m} \tag{2}$$

Where $x^{'}$ is the input standardized data after normalized.

Step 3: Get the eigenvalue value and the eigenvectors of coefficient matrix R, make $|R - \lambda I| = 0$, get $\lambda_i (i = 1,2,...,m)$:the eigenvalues of matrix R, they are the variance of principal components, and sort them from the largest to the smallest, it can array as: $\lambda_1 \geq \lambda_2 \geq ... \geq \lambda_m \geq 0$, and the corresponding eigenvectors can be array as: $\alpha_1, \alpha_2, ..., \alpha_m$, then the number i principal component can be represented as:

$$y_i = \alpha_i^T x = \alpha_{i1} x_1 + \alpha_{i2} x_2 + ... + \alpha_{im} x_m, i = 1,2,...,m \tag{3}$$

Step 4: Determine the principal components. Select the number of principal components: p ($p < m$), and let their accumulative contribution rate $\eta = \sum_{i=1}^{p} \lambda_i / \sum_{j=1}^{m} \lambda_j$ exceed 85%.

In this paper, we use PCA method to process the data of various physical-chemical factors(original variables) related to algae growth, make a linear combination with them, and get the new variable factors(principle components) which have more relation and significant effect to the system output.

3 Fuzzy BP Network System and Its Learning Algorithm

Fuzzy BP network is one kind of fuzzy dynamic system which can be constructed hierarchically by the calculation procedure of fuzzy logic system, and implemented by BP(back-propagation) learning algorithm. It does not change the basic functions of fuzzy logic systems, such as: fuzzier, fuzzy inference and defuzzier,etc. The fuzzy rules can be made by sample data, and the system has the capability of self-learning and self-adaptation.

3.1 Fuzzy BP Network Architecture

Fuzzy BP network structure is shown in Figure 1, the system is divided into three layers, it can be understood as a three-layered feed-forward network, and their parameters can be adjusted by the method of back-propagation, so it can achieve the purpose of learning for the fuzzy logic system.

The function of the first layer: make the input variables as fuzzy variables, and choose the Gaussian type membership function: $\mu = \exp[-(x-\bar{x}_i^j)^2/(\sigma_i^j)^2]$, according to the number of fuzzy rules, we can do the product reasoning by fuzzy implication, and get the output result z^l by this kind of reasoning.

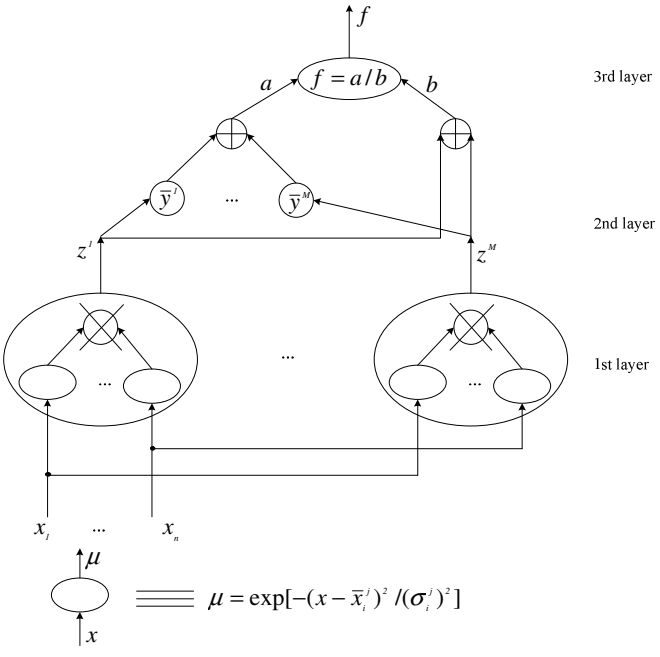

Fig. 1. The structure of fuzzy BP network

The function of the second layer: get the numerator a and denominator b of the expression formula of defuzzier, a is the sum of each product between the centre point value of Gauss membership function for output fuzzy variables and z^l under each rules, b is the sum of each z^l under each rules.

The function of the third layer: complete the defuzzier process of the system: $f = a/b$, and get the system output.

A fuzzy logic system represented as $f = \sum_{l=1}^{M} \bar{y}^l z^l / \sum_{l=1}^{M} z^l$ (l is the number of fuzzy rules, M is the dimensions of the fuzzy BP system) had been proven that it can approach any non-linear function defined in an intensive set with arbitrary precision, and this kind of system can be regarded as an universal approximator [6]. It can describe the relationship of nonlinear mapping between various physical-chemical factors of the marine environment and the state of algae reproduction.

3.2 Fuzzy BP Learning Algorithm

The performance indicator can be chosen as follow:

$$E = \frac{1}{2}\left[f\left(x^p\right) - d^p\right]^2 \tag{4}$$

Here f is the practice output of the model system, d is the desired output.

The weights in the network can be adjusted by the method of the steepest descent, after searching and adjusting in negative gradient direction for the weight coefficients according to E, we can obtain:

$$\overline{y^l}(k+1) = \overline{y^l}(k) - \alpha \frac{f-d}{b} z^l \tag{5}$$

Where α is learn step length and it can be chosen as 0.5,

$$a = \sum_{l=1}^{M} (\overline{y^l} z^l), b = \sum_{l=1}^{M} z^l, z^l = \prod_{i=1}^{n} \exp[-(\frac{x_i - \overline{x_i^j}}{\sigma_i^j})^2],$$
$$f = a/b, l = 1,2,...,M, k = 1,2,...,n$$

Similarly, we can get the parameters: $\overline{x_i^l}$ and σ_i^l of Gaussian membership function for the input fuzzy variables:

$$\overline{x_i^l}(k+1) = \overline{x_i^l}(k) - \alpha \frac{f-d}{b} (\overline{y^l} - f) z^l \frac{2(x_i^p - \overline{x_i^l}(k))}{\sigma_i^{l2}(k)} \tag{6}$$

$$\sigma_i^l(k+1) = \sigma_i^l(k) - \alpha \frac{f-d}{b} (\overline{y^l} - f) z^l \frac{\left(x_i^p - \overline{x_i^l}(k)\right)}{\sigma_i^{l3}(k)} \tag{7}$$

Fuzzy BP algorithm can be implemented by two steps: 1) for a given input variable x_i, we can forward calculate the parameter $z^l (l = 1,2,...,M)$ of fuzzy BP network system, and then get a, b, f based on z^l; 2) Inverse iteration using formula (5) (6) (7), constantly adjust the parameters: $\overline{y^l}, \overline{x_i^l}, \sigma_i^l (i = 1,2,...,n; l = 1,2,...,M)$ to get the minimum deviation of system output.

4 The Prediction Experiment

4.1 Determine the Main Related Environmental Factors Related to Algae Reproductive Status

Ordinarily the environmental factors related to algae reproductive status include: the content of nitrate, light transparency of seawater, seawater temperature, salinity of

seawater, oxygen solubility of seawater, etc. The content of chlorophyll-a can usually be regarded as the most direct indicator for the status of algae reproductive [7],[8]. In a place of seashore in eastern China, we had done some experiments and obtained experimental observation in practice, after data processing, we got 300 groups of sample data observed from seawater environment with the same interval time.

Firstly, we choose the input and output variables of the initial model of the prediction system, select the chlorophyll-a as the output variable of the prediction system, and select nitrate, light transparency, temperature, salinity, the amount of oxygen solubility and the last time of status of chlorophyll-a as the input variables of the system. According to the sample data, we had used PCA method to process these six input variables [4], and got the correlation coefficient matrix, the result could be seen in Table 1. We can see the index of relevance among these six factors from the table. Thereinto, the correlation coefficient between the temperature and salinity is 0.553, the correlation coefficient between the temperature and oxygen solubility is -0.691, and the correlation coefficient between salinity and oxygen solubility is -0.654. Then we can pick-up the independent variables, and choose the representative factors to structure the input variables of the fuzzy BP network system.

According to the correlation coefficient in Table 1 and the implementation steps 1-4 of PCA, we get the eigenvalues of correlation coefficient matrix R and the calculation result of contribution rate of these 6 factors, which are shown in Table 2. We can see that the contribution rate of the first and the second factor is 44.398% and 20.447% respectively in Table 2, the accumulated contribution rate of the front four factors $\geq$ 90.409%.

Table 1. The Correlation Coefficients Among The Variables

Physical- chemical factors	Chl.(k-1)	Nitrate	NTU	Temp	Salt	ODO
Chl.(k-1)	1.000	-0.388	0.224	0.232	0.322	-0.178
Nitrate	-0.388	1.000	0.030	-0.419	-0.256	0.323
NTU	0.224	0.030	1.000	0.062	-0.162	0.061
Temp	0.232	-0.419	0.062	1.000	0.553	-0.691
Salt	0.322	-0.256	-0.162	0.553	1.000	-0.654
ODO	-0.178	0.323	0.061	-0.691	-0.654	1.000

Table 2. Eigenvalue of Principal Component and Their Contribution Rate

	Chl.(k-1)	Nitrate	NTU	Temp	Salt	ODO
Eigenvalue	2.664	1.227	0.886	0.668	0.305	0.271
Contribution rate /%	44.398	20.447	14.429	11.135	5.079	4.512
Cumulative contribution rate /%	44.398	64.845	79.274	90.409	95.488	100.000

Note: Chl.(k-1) means the last state of chlorophyll-a

In Table 2, we can see that chlorophyll-a(last time), nitrate, light transparency, temperature are the principal components, their cumulative contribution rate ≥ 90.409%, as usual, if the cumulative contribution rate factor ≥ 85%, these factors can reflect the influence of the whole relevant factors in the system. Therefore we can depend on the front four variables to replace the original 6 variables, and structure the fuzzy BP network model.

4.2 The Prediction Result and Analysis of Fuzzy BP Network

The first 200 groups of data of the 300 groups observation data is regarded as the training data of the model system, and the next 100 groups data is regarded as the testing data. On the basis of PCA method, we do the training work for the sample data and got the structure of fuzzy BP network model. The test data can be used to verify the predicting result, the result of training and verifying illustrates in Fig.2, where the dash dot line is the output of the prediction model, and the solid line is the output of sample data.

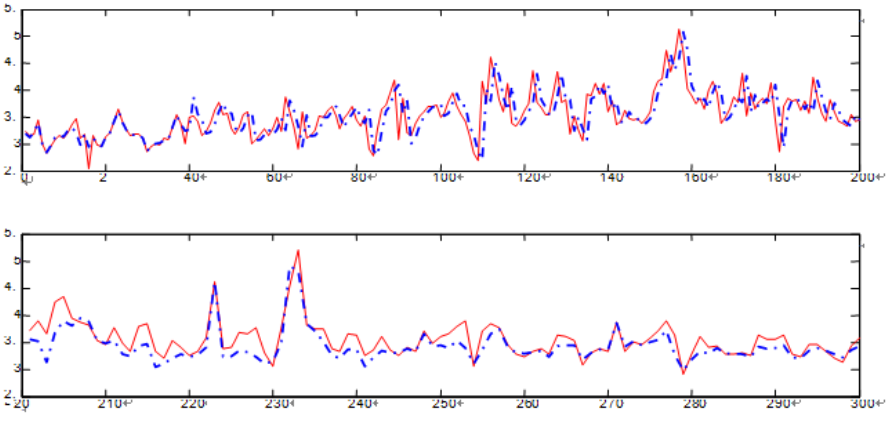

Fig. 2. The training and the prediction result of fuzzy BP network

In Fig.2, the percentage of training error is 0.0607, the percentage of testing error is 0.0638, and the whole MSE is 0.1092. We can see that the fuzzy BP network model based on PCA can better describe this nonlinear system. The prediction result in Fig.2 indicates that fuzzy BP network has the capability of prediction via sample training. It can better predict the possible result of output according to the new data of input variables. On the view of the tracing state of 220-240 test points in Fig.2, it can trace the peak better, and it means the fuzzy BP model has good generalization performance, which could effectively predict the bloom stage of algae reproduction to some extent. This is just the function we concern about in this kind of prediction system.

There are a dozen or more environmental factors related to the changes of chlorophyll-a concentration, but their relevancy degree to the change of chlorophyll-a concentration is different. If we chose all the factors as the input variables of the

model system, the dimension of the model will be very high, and the system will become very complicated. It will bring on slow convergence for the modeling, it will cost a long time to calculate, it causes bad performance of real-time, and it decreases the performance of generalization. By using principal component analysis, we can obtain the principal component variables which have more relationship than others to some extent to the output variables. These variables will be regarded as the input variables of the model, this measure will reduce the order of the model system, shorten the time of training process, improve the performance of real-time response for the model system. In addition the features of fuzzy BP network, it can give a good performance of generalization for the model system.

5 Conclusions

The modeling method of fuzzy BP network based on PCA can effectively reduce the complexity of the nonlinear model system, improve the real time performance of calculation of the model, and have the system has good performance of generalization. In this paper, we use this kind of model to describe the complex mapping relationship between various types of physical-chemical factors and chlorophyll-a in sea water, predict the status of algae reproduction and growth in coast water. Experimental results show that the fuzzy BP network model based on PCA can predict the chlorophyll-a concentration in seawater, and then we can speculate the status of algae reproduction in seawater to some degrees.

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Analysis on the Difficulties of Detecting Infrared Image of the Unconventional Targets

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Abstract. The theoretical analysis on unconventional targets has a high study value on both sides of attack and warning on the naval battlefield. In this paper, based on the introduction of the military value of head-on target with the strongest damage, the physical exercise trait and infrared imaging features of the Head-on targets were analyzed; some difficulties and reasons up to its effective testing were summarized; the research point of single frame detecting and many frames tracking to unconventional targets among Infrared images, which provides reference for research on the detection and tracking algorithm of unconventional targets under the complicated background.

Keywords: Image processing, infrared image, head-on target, target detection.

1 Introduction

In the modern Marine war, people pay special attention to the abilities of ship weapon system such as low resistance, very low altitude penetration, anti-electromagnetism interference and anti-stealth. in order to make the infrared imaging guidance weapon can accurately automatically detect and destroy the targets, the key lies in how to improve the reliability of searching and tracking typical targets and the credibility of identification in complex background and strong interference conditions. Therefore, on the premise of improving infrared detection performance of weapon system, research on implementing effective defense to the typical targets in complex background has become a hot topic.

Modern high-tech weapons can all realize remotely locking target, and all desperately emphasize his whole attack ability, especially the frontal attack power [1-2], which has high study value for head-on targets detection both for the attacker and warning party. research on typical targets of the infrared image features lack of texture and shape and the like can find enemy's military targets such as missiles and the airplane as early as possible, make appropriate response in a relatively short period, capture, track and lock target in long-distance timely, which can gain time for command system's decision-making and weapons system's coping, and improve the survivability and effective counterattack ability of regional defense system. Therefore, research on the theory and technology of detecting head-on targets with typical

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features has profound implications on modern warfare and information war in future. How to analyze infrared image features of head-on attack target is the premise of model establishment of target detection and tracking algorithm of infrared image sequences, which must be taken into consideration. Thus, comprehensive analysis of physical movement characteristics and infrared image features of head-on target in this paper is a foundation of research on relevant theories of irregular target.

2 Status Quo of Equipment Head-On against Ability

Now the high-tech weapons have the directional attack ability, especially frontal attack power. Air combat process normally is Beyond Visual Range (BVR) attack to head-on target firstly, here BVR refers to attack the goals outside 10km, and then the within visual range (WVR) attack to head-on target. America's AIM - 120 missile series [3] have greatly improved in flight speed, range, motor performance, anti-interference ability, and other aspects, especially the terminal active radar seeker, microprocessor and related functional circuits whose maximum effective distance to head-on targets and tail after objectives is 50 kilometers and 10 kilometers respectively, which also impact the inherent pattern of "aiming a dozen one" in traditional air combat, and set off a revolution of Beyond Visual Range air battle. Active radar seeker device on missile together with the radar that scans while tracking on fighter plane makes the fighter plane fire multiple missile and attack several different goal while tracking multiple targets continuously and incessantly.

“Lightning” series [4] is the first public active radar homing missile in China, which can use the typical combat mode of middle inertial plus terminal active radar guidance as well as "after launch no matter" pattern of whole active radar guidance, and can also use "standby on enemy" mode of launching into a predetermined then converting to active radar homing as well as combat mode of whole passive homing. Range of “Lightning” - 10 can reach 70 km in attack for a head-on flying fighter with a speed of 1.2 Mach, and its minimum launch distance not less than 1000 meters.

“Tian Jian” series [5] air-to-air missile were designed by Taiwan imitating the American AIM – “the diamondbacks” Air-to-air combat missile, with maximum speed of 3.5 Mach, the maximum head-on range of 12 km, and has the directional ability to attack. “Tian Jian” - 2 air-to-air missile is a New type of mid-range air-to-air missile with ability of active radar seeking, designed by Taiwan through introducing the technology, with the maximum range of about 50 kilometers (with speed of 1. 2 Mach to maneuver fighter target head-on, high altitude); its maximum range shooting the Low-level frontal target below 1000 meters does not exceed 18 kilometer, and its tail after range does not exceed 6 kilometers.

“Yi Tian” air-defense missile weapon system [6], independently researched and developed by China, are equipped with 8 TY - 90 infrared snatching anti-aircraft missiles. TY - 90 anti-aircraft missiles is mainly composed of the seeker, fuzeassembly, warheads, engine and flight control systems. Missiles can automatically

intercept and track the target, regardless after launch. It Locks target before launch and can off-axis launch. Major tactical performance indexes of missile are as follows: killer distance of 500 ~ 6000 meters, vertical reach of 15 ~ 4000 meters, maximum speed that can attack a head-on target of 400 meters per second, maximum flying speed of 2.2 Mach, single killer probability of 80%.

As is known to all, head-on target has the maximum capability to attack. According to the different models of missile data afore-mentioned at home and abroad, it is known that research on detecting and tracking head-on target has a high application value, and it should also be problem for regular exercise target tracking algorithm, which should be resolved. On the other hand, a head-on point target has such physical characteristics as fast movement speed, good continuity, not obvious trajectory and so on; while the general traditional algorithm cannot effectively deal with target without apparent motion trajectory, unable to make discrimination of head-on target, and then cannot solve the problem of head-on target tracking.

3 Infrared Image Characteristics of Unconventional Target

Infrared radiation characteristics of Target and background are the results of interaction and mutual influence between the target and background. In the study of infrared radiation characteristics of head-on target and background, the background should not be isolated. Therefore, infrared radiation emitted from each part of the target and background has different spectral distribution and radiation intensity, forming infrared radiation distribution features reflecting each attribute of the target and background; this difference is the basis of infrared image background suppressing, target feature extraction and analysis, and object feature extraction model is established based on it.

Head-on target in infrared image contains two meanings: the motion trajectory of target is not obvious, such as low head-on missile target, with high airspeed and great damage, however, because it flying in head-on direction in the infrared image sequences shape in presenting points or spot, without apparent target motion trajectory, it is very easy to be mistaken for noise points or false-alarm point, which is a common content for target detection algorithm that need concern and research. As shown in chart A of figure 1, an aircraft flying in head-on direction under the background of sea sky, because of the far actual distance is, target imaging is small, imaging for point like in the infrared image, imaging for several even a pixel size in the image plane. Transforming the single frame image Top-Hat as shown in chart B of figure 1, in complex cloud or sea background, target can be easily annihilated by noise and various clutter in environment. Image After many frame fusion as shown in chart C of figure 1, moving distance between frames of head-on target has no big changes, which, in the neighborhood with some point as the center, consists with the motion characteristics of target.

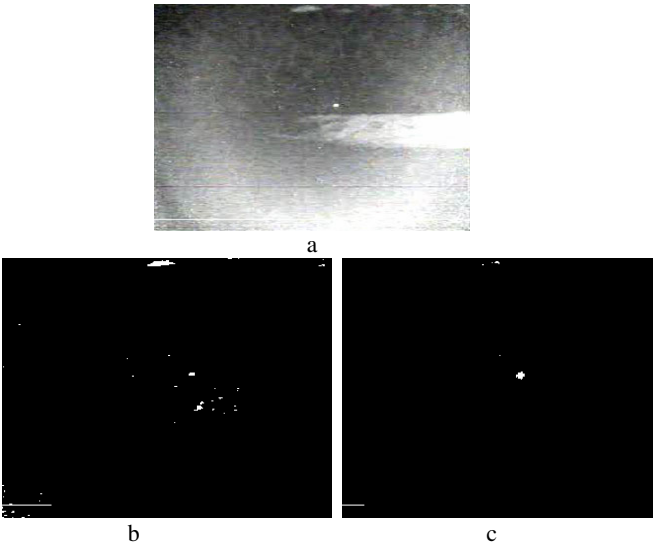


Fig. 1. a) Single Frame Head-On Target Infrared Image b) Single Frame Top-Hat Transformation Image c) Multi Frame Data Fusion Image

4 Research Point of Irregular Target Detection

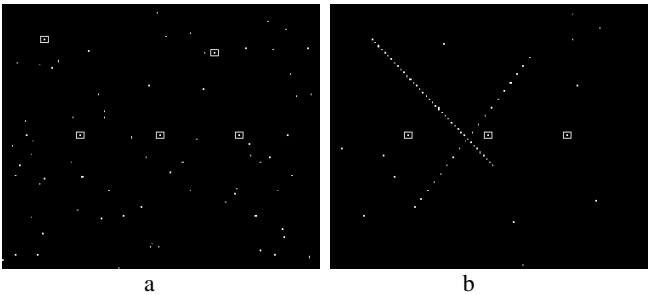
For the head-on point target, under air background, according to its physical properties of fast movement speed, good continuity and not obvious trajectory and characteristics that it has small imaging area and pixels target accounts for has little displacement between adjacent frames in the image sequences [7-8], in military application domain, research point on head-on target detection should be the detection of head-on targets hidden in conventional motion state and multiple head-on point target in complex background.

4.1 Detection of Head-On Targets Hidden in Targets with Conventional Motion State

Detection of head-on targets hidden in conventional motion state is always lack of effective detection methods. Conventional algorithm has very good detection effect on detecting and tracking the moving object with obvious trajectory, but it does not apply to detection of head-on targets with the strongest damage, very easy to process them as false-alarm targets. In military application domain, detection of head-on targets hidden in conventional motion state must be taken into account.

As shown in chat A of figure 2, there are 2 targets with regular motion state and 3 head-on targets in infrared image (size for 320 × 240 pixels) under the emulation image of sea and sky background. Initial position of Regular motion target V1 and V2

respectively is (40, 45) and (50,260); accumulative speed (unit: pixel/frame) of target V_1 and V_2 respectively is $V_{1x} = 2$, $V_{1Y} = 2$, $V_{2x} = 2.5$ and $V_{2Y} = -2$, a total of 40 frames continuously; head-on target V3, V4, V5 respectively located in three positions of (120, 80), (120,160), (120,240), a total of 40 frame images continuously.



a b

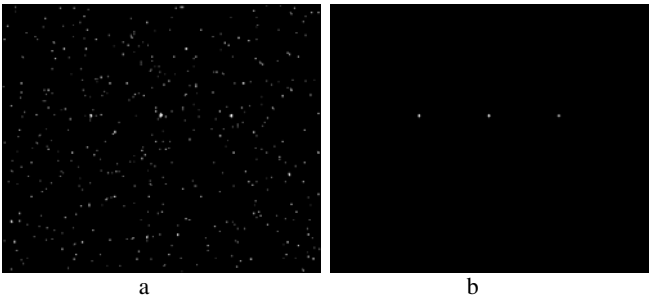
Fig. 2. a) Single Frame Images of Head-On & Conventional Target b) Fused Image of Multi Frame

According to the simulation results (chart B of figure 2) after detection and fusion from multiple frames image, trajectory of conventional target V_1 and V_2 is quite obvious, easy to be detected by common algorithm, while head-on targets V_3, V_4, V_5 have no apparent trajectory, easy to be mistaken for noise targets by common algorithms, ignoring detection of head-on targets with the maximum target and the biggest research value.

4.2 Detection of Multiple Head-On Point Targets under Complex Background

Head-on targets lack prominent motion trajectory, are easily annihilated by noise and cannot be detected, so how to successfully detect the head-on target in high noise condition become the research focus of this field. As shown in chart A of figure 3, the salt-pepper noise with density of 0.1 was joined into image sequences (size of 64×48 pixels) under sea sky background, namely, 30720 simulation false-alarm points were joined into single-frame image. And three head-on point targets V_1, V_2, V_3 whose centers are respectively located in (200,180), (200,320), (200,460), were added to this 30 frames image with high noise. For the sake of clear showing and expressing easily, simulation head-on targets are taken for cross point targets of 5 pixels.

In theory, a head-on point target itself occupy a few pixels, motion distance between adjoining frames in video sequence image is not big, appears in the scope with a certain point as neighborhood domain, while probability that noise appears in the same points randomly changes greatly, as shown in chat B of figure 3; mark image of multi-frame phrase and success number after preprocessing single-frame image, only head-on target pixel has most labeling times of 29, while none of the labeling time of other pixels exceed 12 times; algorithm taking this difference as basis for research , can also effectively realize detection of head-on targets when ensure lower false-alarm rate.



a b

Fig. 3. a) High Noise Background Image of Head-On Target b) Detection Images of Head-On Target

5 Summary

Through introducing the physical motion characteristics and infrared feature of head-on target, detection difficulties of the unconventional targets were obtained: targets are fast in speed, not obvious in track and it cannot be effectively detected by common detection and trajectory tracking algorithm; Targets are similar to the noise in characteristics, which may easily be mistaken for noise and reduce reliability of algorithm. In this paper, summaries and the solutions put forward to the problems of detecting the head-on targets hidden in targets with conventional target motion state provide a reference for research on algorithms of detecting and tracking infrared point-target and head-on target.

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Music Emotion Retrieval Based on Acoustic Features

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Abstract. Music emotion expresses inherent and high-level states of mind and spiritual quality. In this paper, a hierarchical framework is proposed, which consists of two layers: an external layer that represents preliminary and superficial emotions and an inherent layer that represents psychic and resonant emotions. Using these two layers, a Resonance-Arousal-Valence (RAV) emotion model has been constructed. Five feature sets, including intensity, timbre, rhythm, pitch and tonality, and harmony, are extracted to represent music emotions in the RAV model. In order to effectively represent emotions with extracted features, suitable weighting schemes are utilized to balance the different features. As each music clip may have rather complex emotions, a supervised multiclass label model is adopted to annotate emotions with emotion multinomial. Preliminary experimental results indicate that the proposed emotion model and retrieval approach is able to deliver good retrieval performance.

Keywords: Music emotion, music emotion retrieval, resonance, arousal, valence.

1 Introduction

Music is an art form and language that encompasses mind, body, feeling, emotion, culture and other aspects of human beings. In this sense, music plays a vital role in people's daily life, not only relieving stress, but also cultivating sentiment. Since fast development of the Internet and digital devices, there are enormous amount of digital music services. Currently most of music retrieval approaches are based on the traditional metadata information such as the music title artist, genre, and album, for example Pandora.com and iLike. Improved contentbased approaches relying on melody, rhythm, timbre, harmony also strengthen the music retrieval, for example Themefinder and Musipedia. However, according to the study of musicology and psychology [1], emotion is the core component of music that expresses the inherent and high level spiritual quality and state of mind. It is a natural way in an attempt to describe feelings or emotions when people listen to music. Music emotion retrieval satisfies the higher music inherent needs which have significant commercial and research promise.

As emotion is a complex psychological and physiological human subjective and experience, even though for the same music, different listeners may gain drastically different emotions. There are commonly two ways to indicate emotions expressed and induced by music [2]: categorical psychometrics and scalar/dimensional

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psychometrics. Categorical approach utilizes some emotional descriptors or adjectives to express music emotion. Scalar or dimensional approach measures emotions by scalar values or multidimensional matrices. Valence and Arousal are the two-dimensional representation mostly adopted in emotion theory. In this paper, an expanded threedimensional emotion model will be highly constructed to express music emotion. It is Resonance that is defined as the third dimension that represents the psychological influence or spiritual factors which may relate with valence and arousal. The abstract value of resonance ranges from self-destructive to self-constructive. Thus in this three-dimensional emotion model there are eight areas in the emotion space forming eight emotion cubes. However, how to effectively reflecting the relationships between Resonance and Valence-Arousal is still a major problem in philosophy and psychology.

In this paper, a hierarchical framework will be utilized to model music emotion. Using the Resonance-Valence-Arousal (RAV) model, music emotions are able to express in continuous format in the emotion cube. In order to represent music emotion intrinsically and naturally, music informative such as biography and context will be ignored. This paper mainly focuses on the acoustic features in classical music: intensity, timbre, rhythm, pitch and tonality. These five feature sets will be extracted and grouped to represent different dimensions in the RAV space. Thus, each emotion of given music clip will be effectively formalized. As every music clip may contain one or multiple emotion descriptors or labels, supervised multiclass label model and K-Nearest Neighbour approach will be adopted to annotate music emotions with predefined labels. Thus, each music clip in the database is represented by emotion multinomial and labels. Therefore, this paper proposes a query-by-emotion-text approach for retrieval music by ranking them according to index and compare the query emotion multinomial to the previously computed music emotion multinomial in database.

The paper is structured as follows. A brief review of related work is provided in Section 2. Section 3 presents the continuous music emotional RAV model. Section 4 gives the five feature sets extracted for representing music emotions, including intensity, timbre, rhythm, pith and tonality, and harmony. Section 5 deals with music emotion annotation based on RAV values, and retrieve music by emotion. Experiments and performance evaluations will be conducted in Section 6. Section 7 is the conclusion.

2 Related Work

The key factor in music emotional retrieval is to measure and represent emotions induced by music. The most common way to describe emotions is to use adjectives such as pleased, peaceful and sad. However, the amount of these adjectives related to emotion is enormous. Pohle et al. [3] evaluated frequently used audio features for emotion categories (soft, neutral, aggressive) and mood classification (happy, neutral, sad). Music Information Retrieval Evaluation eXchange (MIREX) has already classified music mood into five categorizes by clustering mood labels for popular music. However, the disadvantage of above approach is that emotion expressions are discrete and ambiguous.

Thayer utilizes two-dimensional Valence-Arousal space model, dividing emotions into four quadrants. Thus, the emotion in the plane is regarded as a continuous variable. However, the major problem is how to effectively compute valence and arousal values of the given music. Kim et al. [2] has already given a state of the art review of music emotion recognition. Lu et al. [4] has proposed a hierarchical framework to automatically detect music emotions based on the four clusters derived by Thayer's emotion model. Yang et al. [5], [6], [7] have presented music emotion classification approaches, where categorical and scalar emotion models and regression approach on continuous valence and arousal values were adopted to classify music emotions. Eerola et al. [8] compared two common paradigms of music emotion representation above mentioned, and proposed multidimensional and multivariate regression model to predict music emotions and moods. However, these approaches all have limitations.

Feature extraction from the audio music is another key factor to effectively formulate music emotion. Nicola Orio in [9] has already introduced basic music elements and concepts such as Pitch, Intensity, Timbre, Tempo, Tonality, Rhythm, Melody and Harmony, which are able to represent the music contents. Lu et al. [4] extracted intensity related to arousal, timbre and rhythm which are related to valence to build emotion model. Intensity is often computed by audio energy, and Mel-frequency cepstral coefficients (MFCCs) are utilized to represent timbre. Average correlation peak and the ratio between the average peak and valley strength are extracted to represent rhythm. Kim et al. [2] also summarized acoustic features such as root-mean-square energy, spectral shape and contrast, zero-crossing rate, rhythm strength and regularity influencing emotions.

Though less paper addressed music emotion retrieval in the past few years, there are still other related work and approaches available. Turnbull et al. [10], [11], [12] presents supervised multiclass labeling model to semantically annotate music and retrieve music by rank-order music through calculating Kullback-Leibler divergence. [13] developed a fuzzy inference-based music emotion recognition system based on mapping features to a two-dimensional space. According to the related work, this paper will utilize query-by-emotion-text approach to retrieve music.

3 Music Emotion Model

As mentioned above, one major impediment to music emotion retrieval is how to effectively build an emotion model. On the basis of musicology and music psychology, this paper proposes a hierarchical emotion framework, which consists of two layers: an external layer that represents preliminary and superficial emotions and an inherent layer that represents psychic and resonant emotions. Using these two layers, a Resonance-Arousal-Valence (RAV) emotion model has been constructed. Valence ranges from low to high and arousal ranges from negative to positive reflecting external layer. Resonance with range from self-destructive to self-constructive describes the internal layer. Therefore, this RAV emotion model can be regarded as a three-dimensional music emotion space that consists of eight subspaces which represent continuous emotions.

After the music emotion model is constructed, music emotion is denoted by $E = <cube_i, rav_j>$, where $cube_i$ represents the i-th cube in this RAV space, and rav_j

represents the j-th music clip emotional values, denoted by rav_j = <$resonance_j$, $arousal_j$, $valence_j$>. Suppose arousal α, valence ν are independent variables, resonance γ has a relationship with α and ν, and unknown factors denoted as β which represents harmony in the following section, thus γ represents by $\gamma \approx f(\alpha, \nu, \beta)$. Given a set C = {$c_1$, c_2, · · ·, c_8} to describe these eight cubes, music emotion may be represented as E = <c_i, $(f_i(\alpha_j, \nu_j, \beta_j), \alpha_j, \nu_j)$>. Taking Beethoven's "Ode to Joy" as example, the emotion of this music is expressed by E_b =<c_1, $(f_1(\alpha_b, \nu_b, \beta_b), \alpha_b, \nu_b)$>.

In order to simplify computation, α, ν and γ is confined to [-1, 1]. Multivariate linear regression will be utilized to estimate γ in the following equation.

$$\gamma = b_0 + b_1\alpha + b_2\nu + b_3\beta + \epsilon, \epsilon \sim N(0, \sigma^2) \tag{1}$$

where b_0, b_1, b_2, b_3, and σ^2 are unknown independent parameters,and -1 < α, ν, β < 1 . Least square method is utilized to estimate above regression coefficients. Then, we calculate the partial derivatives with respect to these four parameters, after that these four partial derivatives are assigned to zero.

$$Q = \sum_{i=1}^{n}(\gamma_i - b_0 - b_1\alpha_i - b_2\nu_i - b_3\beta_i)^2 \tag{2}$$

$$\frac{\partial Q}{\partial b_0} = -2\sum_{i=1}^{n}(\gamma_i - b_0 - b_1\alpha_i - b_2\nu_i - b_3\beta_i) = 0 \tag{3}$$

$$\frac{\partial Q}{\partial b_j} = -2\sum_{i=1}^{n}(\gamma_i - b_0 - b_1\alpha_i - b_2\nu_i - b_3\beta_i)x_j = 0 \tag{4}$$

where j = 1, 2, 3, and $x_j = \alpha_i, \nu_i, \beta_i$. Thus according to the above equations, estimated regression coefficients b_0, b_1, b_2, b_3 obtained are used to construct predicted regression function to compute γ.

4 Feature Extraction

As mentioned above, feature extraction is the key issue to effective emotion retrieval. Different attributes such as timbre, intensity, rhythm, harmony and different acoustic features such as spectrum and tempo represent different emotional expressions. This paper extracts features of intensity, timbre, rhythm, pith, tonality, and harmony to express emotions in RAV model.

4.1 Arousal-Based Features

Intensity represents loudness or volume of a sound, which is correlated to arousal such as high intensity arousing excited or joyful feelings or emotions, while low intensity

arousing neutral or depress emotions. The acoustic feature often utilized to describe intensity is energy. The average energy of the given music clip called root-mean-square (rms) can be computed by the following equation. Low energy and high energy also used to express percentage of frames contrasted to average energy. Thus, these three factors contributing to arousal.

$$root\ means\ quare(rms) = \sqrt{\frac{1}{n}\sum_{i=1}^{n} {x_i}^2} \tag{5}$$

or low pitch represents different emotional expression such as active or inactive. Tonality reflects hierarchical pitch relationship between center key. They all inspire emotion response from listeners. Thus, in this RAV model, pitch and tonality are regarded as the sub-factors of arousal. This paper considers four factors such as pitch, key, key strength, and mode to express pitch and tonality features.

4.2 Valence-Based Features

Timbre is a key and comprehensive factor to express different emotions. A special timbre inspires valence response from the listener. The acoustic features often utilized to represent timbre are MFCCs, spectral shape and contrast. Spectral shape features contains brightness, rolloff and roughness, which effectively represent valence extent. Brightness is often measured by spectral centroid, and rolloff is the frequency that 85% distribution concentrated is less than. Spectral contrast focuses on peak, valley, and zero-cross, which reflect valence change. Hence, we consider seven factors to influence timbre: MFCCs, brightness, rolloff, roughness, spectral peak and valley, and zero-cross.

Rhythm reflects different duration over a steady background of the beat, which is often related to rhythm strength, regularity, and tempo. A particular rhythm inspires valence response from the listener. The acoustic features utilized to represent rhythm are onset, fluctuation, event density, and tempo, which constitute the four factors contributing to rhythm.

4.3 Resonance-Based Features

Harmony refers to simultaneously performed tones or chords that represent mixture sounds such as muddy, sharp, and smooth. Harmony is based on consonance, and compared with RAV model, harmony corresponds to resonance. Hence, we employ two factors such as fusion and roughness to represent music harmony.

4.4 Feature Representation

After the computable features are extracted from the audio music, music emotion will be transformed and represented by arousal-based, valence-based and resonance-based features in the RAV model through principal component analysis. In order to simplify computation, all numeric features have been normalized to the range [-1, 1].

5 Music Emotion Retrieval

Here, we utilize query-by-emotion-text to the retrieval of music. Thus music in the database have to be annotated with emotion labels first. Considering each music emotion may contain multiple emotion adjectives such as comfortable, happy, supervised multiclass labeling model will be adopted in music emotion annotation.

5.1 Music Emotion Annotation

Music annotation can be regarded as a multi-class or multilabel problem in which each emotion descriptor or labels represents a class and the goal is to label each music with a subset of emotion labels predefined. Hence, we adopt the K-Nearest Neighbor (KNN) approach to annotate music emotions. Given a music training set M = $\{m_1, m_2, \cdots, m_i\}$, these examples are in the same cube of RAV emotion model. Each training example is labeled with one or multiple predefined emotion labels. Thus, music emotion annotation is to label an unknown emotion of music q with these emotion labels. In the training sample,music with the same emotion labels will be selected as k nearest neighbors. The expectation of music emotion $\overline{m} = <\overline{\gamma}, \overline{\alpha}, \overline{\nu}>$ with the same labels will be computed by these k nearest neighbors in RAV model.

$$\overline{\gamma} = \frac{1}{k}\sum_{i=1}^{k}\gamma_i,\ \overline{\alpha} = \frac{1}{k}\sum_{i=1}^{k}\alpha_i,\ \overline{\nu} = \frac{1}{k}\sum_{i=1}^{k}\nu_i \tag{6}$$

Suppose one music clip with multiple emotion labels, there is no priority among these labels, a discounting factor ϱ is utilized to adjust expectation of music emotions.

$$\overline{\gamma} = \frac{1}{m}\sum_{i=1}^{m}\gamma_i + \varrho * \frac{1}{n}\sum_{j=1}^{n}\gamma_j \tag{7}$$

$$\overline{\alpha} = \frac{1}{m}\sum_{i=1}^{m}\alpha_i + \varrho * \frac{1}{n}\sum_{j=1}^{n}\alpha_j \tag{8}$$

$$\overline{\nu} = \frac{1}{m}\sum_{i=1}^{m}\nu_i + \varrho * \frac{1}{n}\sum_{j=1}^{n}\nu_j \tag{9}$$

where m + n = k. Therefore, the Euclidean distance between q and $\overline{m}$ is calculated as follows:

$$distance(q, \overline{m}) = \|(\gamma_q, \alpha_q, \nu_q) - (\overline{\gamma}, \overline{\alpha}, \overline{\nu})\| \tag{10}$$

Emotion multinomial is defined by standard deviation between q and M in RAV model as follows.

$$standard\ deviation(q) = \sqrt{\frac{1}{k}\sum_{i=1}^{k}(rav_q - rav_{m_i})^2} \tag{11}$$

According to the emotion distance and standard deviation, a threshold ϱ is set to decide the emotion labels given to the novel music. Thus, supervised multiclass labeling based on KNN is able to effectively annotate music with multiple emotion labels.

5.2 Emotion Retrieval

After music emotion annotation is completed, it is very natural and convenient to retrieve music based on their emotions. In order to efficiently retrieve music, a hash table data structure is built to index music based on their emotions. Search keys are emotion labels such as comfortable, happy. In the same search key, there may be many music stored in the gradually increasing order of emotion multinomials computed. Hence, we use a query-by-emotion-text way to construct music emotion retrieval. When users enter a query string which must be emotional labels, a query multinomial is build $\omega = \{\psi_1, \psi_2, \cdots, \psi_n\}$, where ψ_l is in the predefined emotion label collections. More weights will be given to labels that appear earlier in the query sting, and thus accurate query results will be returned in a reasonable way.

6 Experiments

There are 150 classical music clips in the dataset (120 training set, 30 test set), whose style contains concerto, sonata, symphony, and string quartet. These digital music clips are in an uniform format, with sampling rate 22,050Hz, 16 bits, mono channel and 30 seconds length. There are 24 predefined music emotion labels in the three-dimension RAV model, and each cube contains 3 labels. These emotion labels are collected from music informative contexts, biographies, and descriptions, which are able to represent music emotions. MIRtoolbox and PsySound are useful tools to extract acoustic features from audio music. After principal component analysis, computation and normalization, these emotions of music clips are able to be expressed in the RAV space. Thus, taking Beethoven's "Ode to Joy" as example, the emotion of this music is computed by $E_\flat$ = <c_1, (0.76153, 0.81584, 0.73572)>. In the music annotation process, we choose five-nearest neighbors each emotion label as the training set to annotation emotions of new music clips.

Thus, table 1 shows the annotation precision, retrieval precision and recall for querying with one and two emotion labels. The annotation criterion is that the threshold _ is assigned to 0.05. From the analysis, if k is larger, more accurate annotation results will be gained. If more accurate feature values extracted form the audio, more accurate annotation of music by emotion labels will be obtained.

Table 1. Emotion Annotation and Retrieval Results

Label Length	Original	False	Miss	Precision
One label	16	2	3	68.75%
Two labels	14	3	3	57.14%
Label Length	**Retrieved**	**False**	**Precision**	**Recall**
One label	9	3	66.7%	54.5%
Two labels	13	5	61.5%	53.3%

7 Conclusion

This paper proposes a hierarchical music emotion framework, which consists of two layers: an external layer that represents preliminary and superficial emotions and an inherent layer that represents psychic and resonant emotions. Based on these two layers, a reasonable music emotion model Resonance-Arousal-Valence (RAV) model is constructed. The advantage of this model is that it represents emotions in a three-dimensional and continuous space. Music will be placed in the RAV space based on the extracted feature sets: intensity, timbre, rhythm, pitch and tonality, and harmony. Supervised multiclass labeling based on KNN method is adopted to effectively annotate music with multiple emotion labels. Emotion multinomial and hash table are used to retrieve music based on query-by-emotion-text. The preliminary experiment results show that the model is able to deliver good retrieval performance.

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A Remote Mutual Situation-Aware Model by Detecting Entrance and Exit Behaviors in Smart Home

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Abstract. Internet of Things (IoT) is becoming a hot topic in the research field recently. Smart home, which provides comfortable living environment to users with advanced technologies, is an important application field in IoT. With a large number of people who live remotely from family members, smart homes should provide not only convenient and comfortable services in a single house, but also mutual communication services to enhance interaction between family members. Unlike usual communication methods such as phone call, email, and chatting tools with human intentions, we propose a remote mutual situation-aware model between smart homes to let users contact with other family members in an unintended way. A prototype system has been implemented by detecting entrance and exit behaviors in smart homes. Through a feasibility confirmation evaluation of the system, the system worked well and could correctly reflect the entrance and exit behaviors in a remote smart home.

Keywords: Internet of Things (IoT), Protocol of IoT, Application of IoT, Smart homes, Mutual situation-awareness.

1 Introduction

Internet of Things (IoT) is becoming a hot topic and research field recently. The basic idea of IoT is that variety of smart objects augmented with various abilities, e.g. sensing, wireless communication, processing etc, are able to interact with each other and cooperate with their neighbors to reach common goals.

Smart home is an important application field of IoT. Users, especially elderly persons can enjoy comfortable living environment provided by the techniques and services of smart home [1] [2].

Nowadays, a large number of people live remotely from their family members due to work, study, or any other reasons. Although communication methods and network technologies, such as cell phone, email, web-chatting, and webcam are well developed, all of the above communication methods are based on the assumption that users can realize the lack of communication among family members, and then actively start a connection. However, users may not be aware of the lack of connection and too much

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connection by cell phone or web-chatting may bring a big burden to the users. For example, from sun/daughter's point of view, they are willing to concern their parents, but perhaps since full schedule they won't contact the elderly or other members every day. From the elderly point of view, they may want to know the basic situations of children's families (e.g. grand children) every day. But too much connection by cell phone may let children feel burden and boring. Therefore, there is a need for a mechanism to trigger connection automatically and in an unintended way based on the situations of users.

Situation awareness is a special kind of context awareness which considers the situations around users in more details, and provides services more comprehensively. However, there is almost no mutual situation awareness to provide services based on the situations of remote families.

To this end, we propose a new mutual situation-aware communication model between smart homes, aiming at enhancing interaction between remote family members. By using this model, family members can contact with each other without intentions or deliberations, automatically triggered based on the situations around users. And also users will not feel heaviness caused by frequent but less important call. In this model, we will collect data of user's daily life in smart homes and analyze the data to get user's basic daily life patterns. Then we will provide a communication protocol, which is situation-driven as default, but also can let user configure their own communication mechanism including time, status, and priority. That means the protocol can be tuned according to families' requirements or inputs. In order to build the model, there are three problems needed to be solved:

1. What kinds of data should be collected and how to collect daily life data in smart homes;
2. How to select useful and meaningful data and transfer the selected data to remote family in another smart home at the right time;
3. How to interpret and display the received data at an appropriate time and right indoor place to the right user; In this paper, we will start our work from a simple communication case: detecting entrance and exit behaviors in a smart home and let the remote family be aware of the presence of the users.

The rest of the paper is organized as follows. Section 2 is about some related researches. Section 3 gives model of the proposal. Section 4 presents the design, implement and basic evaluation of the system in detail. Finally, the paper is concluded in Section 5.

2 Related Researches

Smart home is one of hottest applications/topics in IoT. Many works have been done in the area of smart homes. In [3], Antonio Sanchez et al. discussed the research and technologies around the area of smart homes. Most of the related technologies, including artificial intelligence, ontology, and sensor networks are mentioned in it. These works however focus primarily on sensing people and environment to improve the life of its inhabitants in a single house.

For smart home communications, researchers prefer to devote time to solve the network and communication and networking issues for a single smart home.

There are also large numbers of researches about providing health assisting to the elderly in smart home. In [4], Ali Maleki Tabar et al. builds a Smart Home Care Network between user and care-giving center to help elderly and people in need of monitored living independently.

In [5], the author proposes an Ambient Assisted Living (AAL) encompasses technical systems to support elderly in their daily routine to allow an independent and safe lifestyle as long as possible.

Most of the above researches pay attention to how to deal with difficulties in elderly daily life. However, the psychology problems such as feeling lonely have not been considered.

To provide right service to right person in smart home, context awareness is therefore an important technology issue to realize the real smart homes, especially for elderly users, which emerged out in ubiquitous computing research at Xerox PARC and elsewhere in the early 1990s.

Many researches have been performed on context awareness in smart home, in various aspects, e.g. instrumentation, middleware, privacy etc.

For instrumentation, many researches have been performed. For example, Smart-Its [13] has been proposed, including small-scale embedded devices equipped with sensing, processing and communication capabilities. MediaCup [12] has been proposed to detect the temperature and movement of cup by embedding sensors, MCU etc. For middleware, Schmidt and Van Laerhoven introduce the concept of cues [6] has been proposed which provides an abstraction of actual sensor. Recently a smart gate based composition method has been proposed in [8, 14], to coordinate the work of multiple smart objects in smart home. And also many researches have been performed on privacy issues of context awareness. For example images of people can be blurred in order to protect their privacy in [15].

However, the above researches still only considers the context-aware of a single user in a single house. There is almost no research on modeling mutual situation awareness to provide services based on the situations of remote families.

3 Mutual Situation-Aware Model

The model is shown in Fig.1. Firstly, we assume that there are two smart homes, “Smart Home A” and “Smart Home B”, with lots of smart devices, integrated with various abilities, e.g. sensing, computing, and communicating. These smart devices include some furniture such as door and bed, and some electronic devices like PC or TV. For simplified discussion, we assume that each smart home has only one user living in it, called User A and User B respectively. Both smart homes have their own servers, respectively Server A and Server B, as agents in charging of the collected data and communicating. In the communication part, we propose a transferring protocol for the following 3 problems:

1. What kinds of data should be sent?
2. How to transfer the data?
3. When to send the data?

So the protocol should contain two factors, timing and format, which we will be discussed in Section 4. With smart devices, it is possible to collect the daily life data by

kinds of sensors integrated in them. For instance in Fig.1, entrance and exit behavior can be detected by RFID sensors, eating behavior can be detected by camera, and sleep behavior can be detected by pressure sensor on the bed. Additionally, when these behaviors or activities occur, the related data including location, time, and relevant person also can be recorded. We call them situations, which can be automatically composed based on methods in [7][8].

Generally speaking, the situation data transferring in the model is situation-driven, which means the data will be sent when a situation occurs. From all we mentioned above, we can acquire message logs in server agent of every user. Through analyzing the logs, we can obtain at least 3 pieces of information listing below:

1. Daily life patterns of every user;
2. Most concerned situations,
3. The relationships (not relative relationship) between family members, living in different houses.

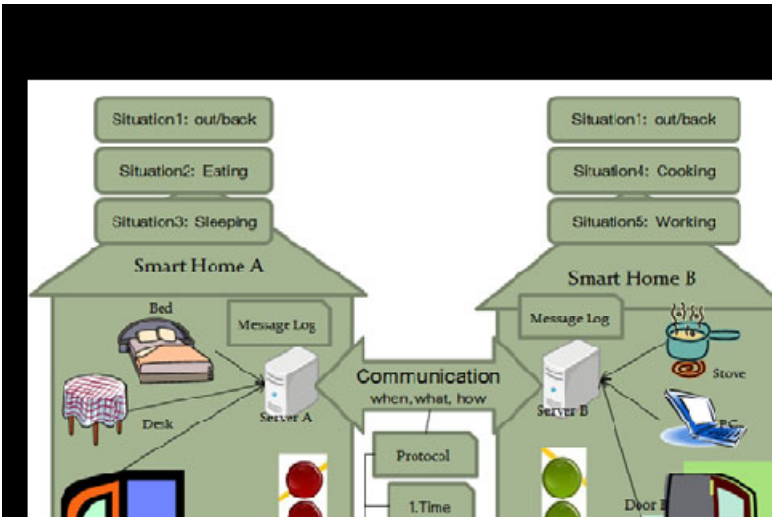

Fig. 1. Model of Smart Homes

4 Design and Implementation

In this paper, we will start from a simple mutual situationaware case: automatically informing remote family member based on the entrance and exit behaviors, e.g. when a user goes outdoors or comes back indoors. Besides, the movements of indoor location also can be sent to the remote family member.

The entrance and exit behaviors and the indoor location movements will be detected by U-tiles sensor network (See [9][10][11] for detail). As shown in Fig. 2, the U-tiles consist of some tiles on a floor. Each tile is embedded with an antenna of RFID reader and 4 pressure sensors. The system can detect RFID tags attached on the user or

objects, when the user or objects are on the tiles, and their positions in the room. When the user comes back or goes out, RFID U-tiles will capture the behaviors and send to the server agent in smart home.

Firstly, we suppose that there are 3 rooms, kitchen, bedroom, and bathroom, in each smart home. The construction of the house is shown in Fig. 3. We can judge the entrance and exit behaviors through detecting the user position serials on the tile, e.g. if the position serial is from

Tile 2 to 3, we can say the user enters kitchen; else if from Tile 3 to 2, we say the user exits kitchen.

Aiming at letting user interact with remote family member in an unintended way so that they feel as if they lived together, it is necessary to let the user be aware of the existence of remote family member. Thus, we choose to use LED lights to let the user be aware of the location situations of remote family members. We use 4 LED lights in every smart home to represent entrance and exit behaviors of remote families as shown in Table 1.

When home LED is on, it means remote family member is back while off means outdoors. Similarly, bathroom LED, kitchen LED, and bedroom LED show that the remote family member is in the room or not.

In Table 2, we design a format for situation aware communication which is situation-driven. In this paper, we just consider eight situations. The format contains 4 fields: Situation ID, Time, Activity, and Words.

A communication system is built to implement the model. The detail architecture of this system is shown in Fig. 4. Utiles sensor network is connected to the server agent. And every agent is connected to a Cute-Box, which is an embedded board we implement home lights in Table 1 on.

The basic work process is as follows. When U-tiles in smart home A detects entrance and exit behaviors, the data are sent to Agent A. Agent A transfers the data to Agent B in another smart home, then Agent B analyzes the data and flush to Cute-Box B. Finally, corresponding LED-B changes status according to the data sent by Cute-Box B based on Table 1.

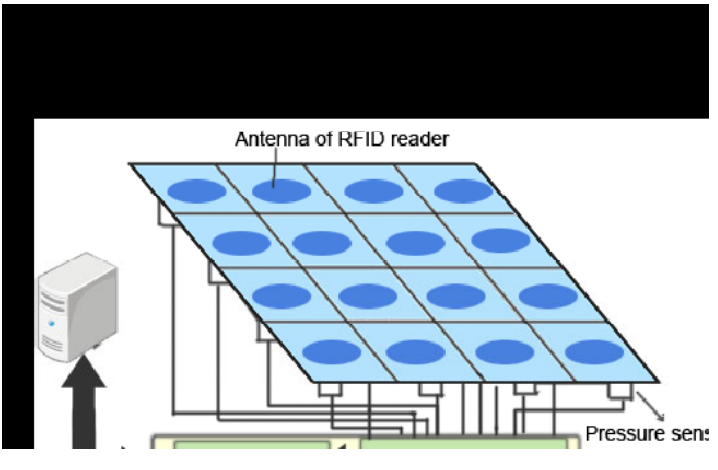

Fig. 2. Structure of the U-tiles

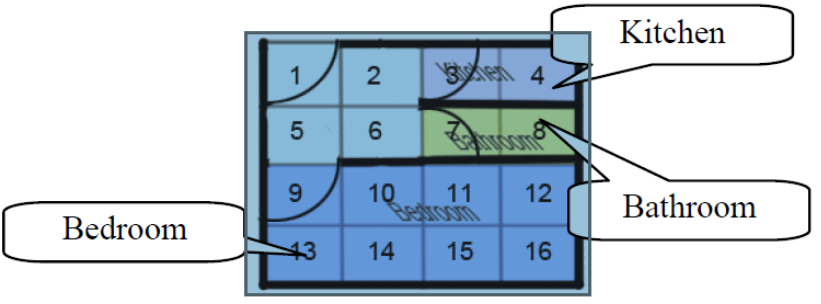

Fig. 3. Constructionof the smart home

Table 1. Led lights status

LED Lights in smart home A	Entrance and Exit Behaviors in smart home B	
	On	*Off*
hmLED-A (Home LED)	User B is at home	User B is out of home
ktnLED-A (Kitchen LED)	User B is in kitchen	User B is out of kitchen
bthLED-A (Bathroom LED)	User B is in bathroom	User B is out of bathroom
bedLED-A (Bedroom LED)	User B is in bedroom	User B is out of bedroom

Table 2. Situation format

Format Fields			
Status ID	*Time*	*Activity*	*Words*
S11	XX:XX	Come back	I'm back!
S12	XX:XX	Go out	I am going out!
S21	XX:XX	Enter kitchen	I'm in kitchen.
S22	XX:XX	Exit kitchen	I'm not in kitchen.
S31	XX:XX	Enter bathroom	I'm in bathroom.
S32	XX:XX	Exit bathroom	I'm not in bathroom.
S41	XX:XX	Enter bedroom	I'm in bedroom.
S42	XX:XX	Exit bedroom	I'm not in bedroom.

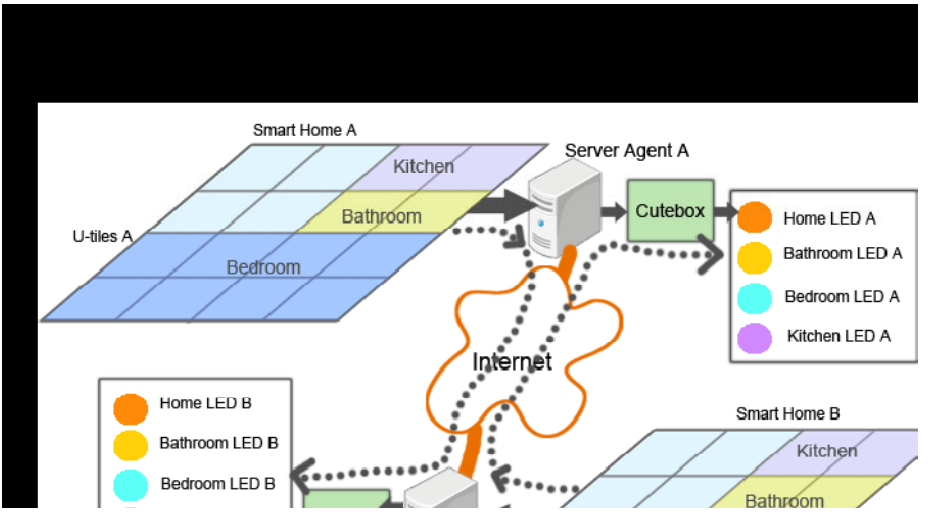

Fig. 4. Architecture of the communication system

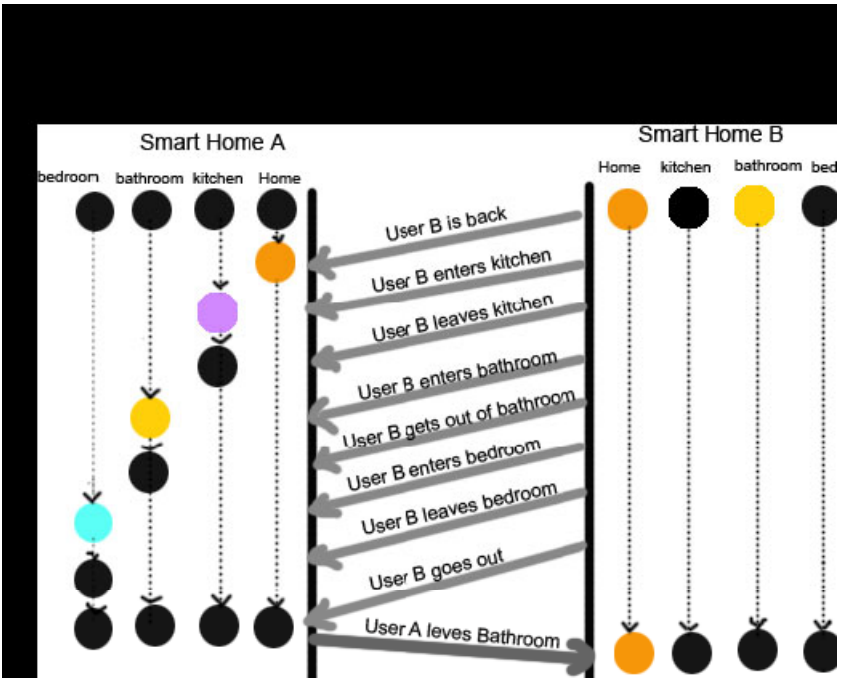

Fig. 5. Communication Case

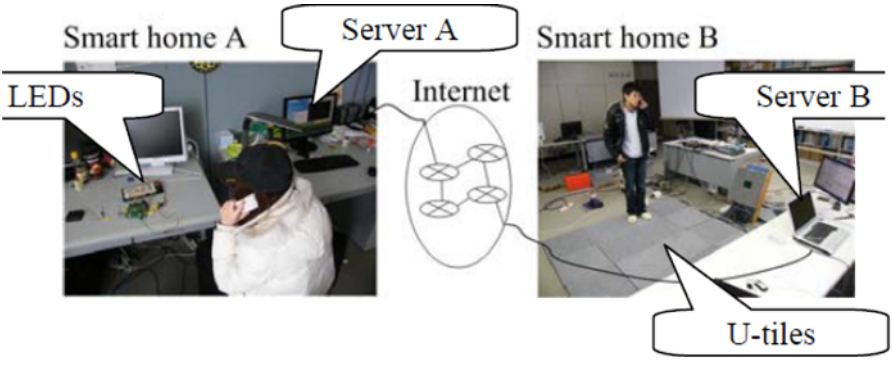

Fig. 6. Snapshot of experiment

A simple case is shown in Fig. 5 to show the sequence of how the LED lights work. Firstly, we assume that in Smart Home A, User A is at home and is in bathroom as initial status, so hmLED-B and bthLED-B are both off in Smart Home B. And in Smart Home B, User B is outdoors as initial status, so all the LED lights in Smart Home A are off.

When User B comes back, U-tiles will get the detected behavior and organize it as the format and send the message to Smart Home B, so the hmLED-A in Smart Home A will be turned on. Then User B's movement route in Smart Home B is: kitchen->bathroom->bedroom. And at last s/he goes out. So the LED lights statuses change as in Fig 5. User A leaves bathroom and then the bthLED-B turns off.

We have performed a basic experiment to evaluate the feasibility of the system as shown in Fig. 6. Two persons participated the experiment. One was in the smart home A and the other was in the smart B. The person in the smart B changed different rooms on U-tiles sensor network as designed in Fig. 3. And the person in the smart home A recorded and confirmed the changing of LED. The activities of person in smart home B is as follows, back home- >kitchen->bathroom>bedroom->going out. They talked with each other by cell phone to confirm the location of person in smart home B and the status of LEDs in smart home A. It was confirmed that during the experiment, the LEDs in smart home A correctly reflected the location of the person in smart home B.

5 Conclusion

In this paper, the mutual situation-aware model was proposed to enhance interaction between remote family members in an unintended way. Based on this model, we gave a case study of detecting entrance and exit behaviors and indoor location of the users in a smart home, and implemented this system by using U-tiles RF-ID sensor network.

In the future, we will do more detail experiments to evaluate the system and the proposed model. And in order to fully realize the mutual situation-aware model, we plan to design an application protocol to deal with more complex situations. And more easy-to-use interfaces/devices will be designed to remind users, e.g. wearable devices.

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Offshore Engineering Diving Support for Paving Oil-Gas Pipeline in Gulf Tonkin

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Abstract. This paper introduces the contents and characteristics of diving support for offshore engineering of paving subsea oil-gas pipeline and installing vertical pipe. Aiming at the characteristics of diving operation, the paper analyses and evaluates the difficulty and risk of underwater work, puts forward corresponding security and management measures. Helium oxygen mixture diving technique was used, the maximum diving depth is 70 meters, the following diving work has been done safely and successfully: underwater detection of pipe cradle, detection of subsea pipeline and detection of A/R cable; underwater operation of repairing broken pipe; underwater operation of installing vertical pipe.

Keywords: Offshore oil engineering, paving pipeline, diving support.

1 Introduction

The Offshore oil development is engineering with high devotion and high risk. Working environment is bad, and safe requirements are strict. Diving support for offshore oil engineering is an important assurance. China National Offshore Oil Corporation (CNOOC) has built two oil and natural gas offshore drilling platforms ("CEP" and "WHPE" drilling platform) in the southwestern sea area of Hainan province. Then they will pave offshore oil and natural gas pipeline for "CEP" and "WHPE" platform. Underwater engineering need supported by diver.

2 Engineering Key Point

2.1 Engineering Content and Construction Method

1. Engineering content of Subsea pipeline mainly includes:

1) Paving the subsea oil-gas pipeline from offshore drilling platform to landing zone, the pipe diameter is 22 inches, the distance is 105.3 km, and the underwater working depth is 0~70m.

2) Laying the pipeline between "CEP" and "WHPE", the distance is 3.385 km, the pipe diameter is 12 inches, and the maximum underwater working depth is 70m.

3) Installing vertical pipe for offshore drilling platforms "CEP" and "WHPE", the pipe diameter is 12 inches and22 inches, and the underwater working depth is 0~70m.

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4) Installing working piece for platforms "CEP" and "WHPE".

2. Figure 1 shows the main construction condition of Subsea pipeline. After one pipe (length is 12 meters) is connected by welding, it is sent to trusteeship frame. The piping gradually sinks on the sea bottom with the processing ship moving slowly.

Fig. 1. The main construction method of Subsea pipeline

2.2 Engineering Characteristic and Difficulty

1) Paving such a long distance subsea oil-gas pipeline for the first time in the domestic.

2) The condition of seabed geology is complex, need to dig ditch at 70 m underwater to reduce the distance of piping suspended at seabed.

3) The thickness of coating cement covering pipe reaches 120mm, the underwater weight is heavy (466.4 kg/m, 962.9 kg/m on the land), the former offshore construction design method is changed.

4) The work of vertical pipe installed (Include horizontal pipe hook on) is complex, needs welding installation in 70m underwater (conventional installation of the vertical pipe and horizontal pipe using underwater flange connection). Lacking of practical experience, the risk is higher and difficulty is more.

5) Reliability and compatibility of equipment of paving tube, welding, inspection and other supporting equipment are greater influence on engineering.

3 Diving Safety Management

3.1 Underwater Operating Contents and Diving Environment

1. Underwater operating contents

1) The underwater conjunction of dalliance chain before subsea pipe paved.

2) During the normal period of paving pipeline, the work is underwater detection of pipe and pipe cradle. Diving depth of trusteeship frame detection is 0 ~ 10 m, diving depth of subsea pipeline check depth is same as the pipe.

*3)*Abnormal condition, diver should dive into the bottom of the sea and untie the mooring steel cable of pipeline (A/R cable) when abandon pipe; While rising the tube, diver should dive into the bottom of the sea and guide the engineering ship anchored positioning, Then retie the mooring steel cable to the end of pipeline. Diving depth is same as the water depth.

4) If pipe suddenly ruptures, the broken tube residual and need to be salvaged. First a lifting hole need cut on the broken tube, and then hooking cable is connected to lifting hole by diver. The underwater work of this circumstance belongs to emergency repairing work. Diving depth is same as the water depth.

5) The platform vertical pipe installed. The underwater operating contents include 3: open the bolt fixed at pipe clamp; guide surface crane lifting vertical pipe onto the pipe clamp accurately and carry on initial underwater fix; close the tube clamp and bolt. The maximum diving depth of this stage is 65 meters.

6) The other diving operations related to the project.

2. Diving environment data

Following diving environment data directly affect the safety of diving operations: wind, swell wave, sea current, visibility, seabed sediment and tide. Need to control a circumstance and adopt corresponding measure.

1) Meteorological In winter it is mainly influenced by the northeast monsoon in the southwestern sea area of Hainan province, the wind force is 6-7 classes, biggest 8 classes, strong breeze frequency 32%. In summer it is mainly influenced by the southwest monsoon, the typhoon reaches to 12 classes; the strong breeze frequency is 30%. Annual temperature is in 6.7-34.1℃, average temperature is 24.7℃. Annual rainfall is 87mm - 992.2 mm.

2) Hydrology and geology The construction water is a full-day tide. The highest tide is 3.3-3.7 m, and the lowest tide is 0.23-0.58 m. The rising tide toward the northeast, the average flow velocity is 1.5 knot, the maximum flow velocity reaches to 3 kn. In winter and spring, the surface current is 0.4 knot, and 0.15 knot in 10m underwater, 0.25kn in bottom. The wind currents depend on sea wind force variety. Sea water temperature annual average is 26℃, the winter spring is subjected to the sea water vertical direction convection function, the different depth water temperature presents uniform appearance, the average water temperature is 20.2 ℃ in January, the lowest is 13.7 ℃ .The visibility in water is 5 classes. The sea bottom is a sediment bottom.

3.2 Difficulty Analyzing and Risk Evaluating of Underwater Work

When accept task, a project team is established to carry on organizing and management to the project. Members of the project team, experts and divers analysis the engineering, think that following difficulty and risk is exist.

1) Bad environment of diving operation Wind force in the working sea area usually reach 7 classes, the biggest gust wind measured in 10 years reach to 42.5 m/s. The sea condition are worse, the biggest wave is up to 9.9 m measured in 1 year. The current is faster, affected by tide, windy flow, ocean currents and ocean surges, the

maximum flow speed can reach 4 kn. The duration of flat tide is short. All above influence underwater work safety and work efficiency.

2) Helium oxygen diving operation The maximum diving depth is up to 70m in operation of seabed pipeline paved and vertical pipe installed. Helium oxygen diving technique need to be adopted when the depth of underwater is more than 60 meters. By now, helium oxygen mixture dive in the domestic main used for diving training, lack of practical engineering experience.

3) Possible diving safety problems

The range of underwater operating depth is broad (0-70m), shown as Figure 2. Different diving way should be adopted according to underwater operating depth. Air diving way should be adopted if diving depth is less than 60 meters. SCUBA diving apparatus, surface supported diving apparatus can be chosen. Helium oxygen mixture diving way should be adopted if diving depth is more than 60 meters. Helium-oxygen diving equipment can be chosen.

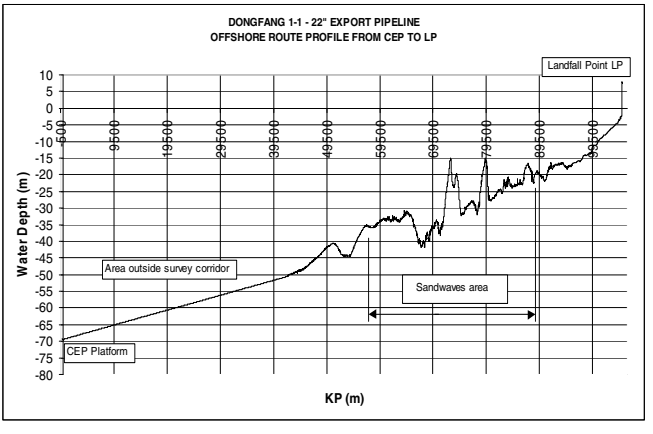

Fig. 2. The curve of underwater operating depth

Work and rest does not rule, project lasts long. The divers operate underwater with good condition, such as weather, sea conditions and the tides. When the condition allows, they usually work day and night, maybe induce the diver's fatigue, and affect the safety. According to the engineering plan, divers live in ship for five months. It is a big challenge to physical and psychological of divers.

4) Underwater operating technology is complex Following technology should be adopted: underwater search, underwater cleaning, underwater detection, underwater welding and cutting and so on. Following underwater operating tools and equipment need to be used: hydraulic tools, welding-cutting equipment, underwater television system and underwater camera.

5) Underwater operating difficulties If pipe suddenly ruptures, firstly divers need to search and find the residual end of broken tube in the seabed, then a lifting hole need cut on the broken pipe, and then hookon cable connected in by diver. The underwater work of this circumstance belongs to emergency repairing work. Diving

depth is same as the water depth. In addition the thickness of coating cement covering pipe reaches 120mm, it is difficulty to clean up the coating cement to cut the lifting hole underwater.

Fig. 3. The ruptured pipe

The platform vertical pipe installed. Divers open the bolt fixed at pipe clamp; guide surface crane lifting vertical pipe onto the pipe clamp accurately and carry on initial underwater fix; close the tube clamp and bolt. The platform has submersed in sea water for 1 year, and caused the fixed tube clamp bolts not to be opened due to seawater erosion and adherent sea creatures.

4 The Project Implementation

Before the project implementation, a set of detailed safety management files were compiled, targeted safe education and professional diving training were organized. According to diving contents, character and project schedule, we decomposed total project target into the specific tasks of various stages. As an example of oil drilling platform vertical pipe installation, the project implementation process is introduced.

(1) *Operating ship anchored in place* The operating ship anchored scheme is drawn up through the analysis of meteorological data in the sea areas. Back of the operating ship is closed to the drilling platform, make divers working water area is in the downstream of wind.

(2) *Diving operating site layout* Including the layout of surface and underwater operating site. One diver dives with a descend line into the site of the lowest vertical pipe clamp along the dipsey lead, and tie up descend line to the clamp, with convenient to diver arrived at the underwater operating site and transfer tools.

(3) *open the pipe clamp fixed by bolt* Arriving at the operating site diver cleans out adherent sea creatures and removes the bolts. It is difficult to open the bolt by the tool of ratchet spanner and hydraulic impact wench because of erosion, some of those can be opened, the work efficiency is lower. The problem is solved by underwater cut technical.

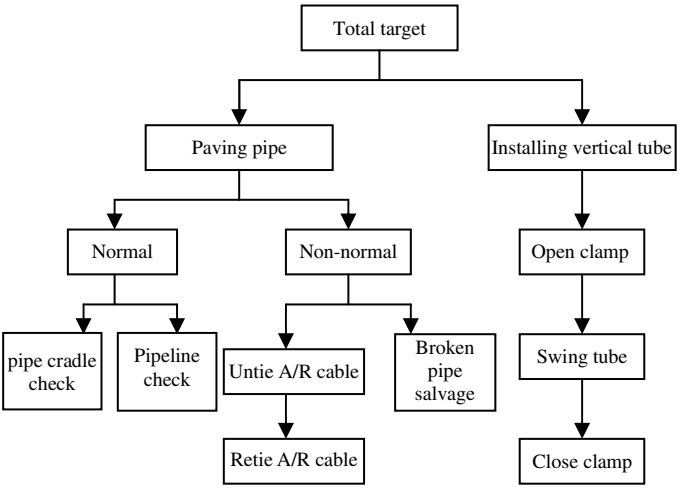

Fig. 4. The diving operating target decomposed by contents and stages

(4)*Vertical pipe installed* Surface crane lifting vertical pipe onto the pipe clamp accurately through the ROV monitoring and diver guiding. Diver untie the fixed cable, close the clamp and carry on initial underwater fix with long bolt. Then replacing the standard bolt fixed.

(5)*Check and acceptance* Divers upload the underwater image of vertical pipe installation and fixing timely to the surface through underwater photography and video. The experts check and accept.

5 Conclusions

The original working duration of offshore engineering of paving undersea oil-gas pipeline in Gulf Tonkin is 130 days, but actually is 195 days. Helium oxygen mixture diving technique was used; the maximum diving depth is 70 meters. The following diving work has been done safely and successfully: underwater detection of pipe cradle, detection of subsea pipeline and detection of A/R cable; underwater operation of broken pipe emergence repaired; underwater operation of vertical pipe installed. Accumulated experience for offshore engineering diving support and helium oxygen mixture diving engineering practice.

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Differential Transform Method for the Degasperis-Procesi Equation

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Abstract. In this paper, the differential transform method is developed to solve solitary waves governed by Degasperis- Procesi equation. Purely analytic solutions are given for solitons with and without continuity at crest. A Pad´e technique is also combined with DTM. This provides us a new analytic approach to solve soliton with discontinuity.

Keywords: Differential transform method, solitary wave, differential transform-Pad´e approximation, discontinuity.

1 Introduction

In this paper, we present differential transform method for the analytic solutions of the Degasperis-Procesi equation

$$u_t + 3k^3 u_x - u_{xxt} + 4uu_x = 3u_x u_{xx} + uu_{xxx}. \qquad (1)$$

For k = 0, DP Eq.(1) has traveling wave solutions of the form $ce^{-|x-ct|}$, called peakons, which capture an essential feature of the traveling waves of largest amplitude.when k $\neq$ 0 the DP Eq.(1) admits smooth soliton solutions in the parametric form [11].

Zhou[2] first introduced the differential transform method(DTM) in solving linear and non-linear initial value problems in the electrical circuit analysis.The differential transform method obtains an analytical solution in the form of a polynomial. It is different from the traditional high order Taylor's series method, which requires symbolic competition of the necessary derivatives of the data functions. The Taylor series method is computationally taken long time for large orders. Ravi Kanth and Aruna have developed this method for PDEs and obtained closed form series solutions for both linear and nonlinear problems[3], [4]. Besides the differential transform method is independent on whether or not there exist small parameters in the considered equation. Therefore, the differential transform method can overcome the foregoing restrictions and limitations of perturbation techniques so that it provides us with a possibility to analyze strongly nonlinear problems. This method has been successfully applied to solve many types of nonlinear problems[5], [6], [7], [8], [9], [10]. All of the previous applications of the differential transform method deal with solutions without discontinuity. However, many nonlinear problems have different types of

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discontinuity. In order to verify the validity of the differential transform method for nonlinear problems with discontinuation, we further apply it to solve shallow solitary water wave problems governed by Degasperis-Procesi equation.

2 Basic Idea of DTM

The basic definitions and fundamental operations of the differential transform method are defined as follows[12], [13]: Consider a function of variable $w(x)$, be analytic in the domain Ω and let $x = x0$ in this domain. The function $w(x)$ is then represented by one series whose centre located at $x0$. The differential transform of the function $w(x)$ is in the form

$$W(k) = \frac{1}{k!}\left[\frac{d^k w(x)}{dx^k}\right]\Bigg|_{x=x_0}, \tag{2}$$

where $w(x)$ is the original function and W(k) is the transformed function.

The differential inverse transform of Un (k) is defined as

$$w(x) = \sum_{k=0}^{\infty} W(k)(x - x_0)^k. \tag{3}$$

In a real application, and when $x0$ is taken as 0, then the function $w(x)$ can be expressed by a finite series and with the aid of Eq.(3), $w(x)$ can be written as

$$w(x)) = \sum_{k=0}^{\infty} W(k)x^k = \sum_{k=0}^{\infty} \frac{1}{k!}\left[\frac{d^k w(x)}{dx^k}\right]\Bigg|_{x=0} x^k. \tag{4}$$

The M-th order approximation of the object function $w(x)$ is given by

$$w(x) = \sum_{k=0}^{M} \frac{1}{k!}\left[\frac{d^k w(x)}{dx^k}\right]\Bigg|_{x=0} x^k = \sum_{k=0}^{M} W(k)x^k. \tag{5}$$

1) Subsubsection Heading Here: Subsubsection text here.

3 Differential Transform-Pad´e Technique

The accuracy and convergency of the solution given by series Eq.(5) can be further enhanced by the differential transform-Pad´e technique. The basic idea of summation theory is to represent f(x), the function in question, by a convergent expression. In Euler summation this expression is the limit of the convergent series, while in borel summation this expression is the limit of a convergent integral. The difficulty with Euler and Borel summation is that all of the terms of the divergent series must be known exactly before the sum can be found even approximately. But in real

computation, only a few terms of a series can be calculated before a state of exhaustion is reached. Therefore, a summation algorithm is needed which requires as input only a finite number of terms of divergent series. Then as each new term is given, we can give a new and improved estimate of exact sum of the divergent series. Pad´e approximation is a well known summation method which having this property.

As a method of enhancing accuracy and convergency of the series,Pad´e approximation is widely applied [14]. The idea of Pad´e summation is to replace a power series

$$f(x) = \sum_{n=0}^{+\infty} c_n x^n \tag{6}$$

by a sequence of rational functions which is a ratio of two polynomials

$$f_M^N(x) = \frac{\sum_{k=0}^{N} a_k x^k}{\sum_{k=0}^{M} b_k x^k}, \tag{7}$$

where we choose b0 = 1 without loss of generality.

We choose the remaining (M+N+1) coefficients $a_0, a_1, \cdot, a_N, b_1, b_2, \cdot, b_M$, so that the first (M+N+1) terms in the power series expansion of $f_M^N(x)$ match the first (M+N+1) terms of the power series $f(x) = \sum_{n=0}^{+\infty} c_n x^n$. The resulting rational function $f_M^N(x)$ is called a Pad´e approximate. We will see that constructing $f_M^N(x)$ is very useful. If Pcnxn is a power series representation of the function f(x), then in many instances $f_M^N(x) \to$ f(x) as N,M $\to \infty$, even if Pcnxn is a divergent series. Usually we consider only the convergence of the Pad´e sequences $f_0^J, f_1^{1+j}, f_2^{2+J}$, having N=M+J with J fixed and M $\to \infty$. If j = 0 then this sequence is called diagonal sequence.

It often works quite well, even beyond their proven range of applicability.We combine the differential transform with Pad´e technique,and call this method Differential transform- Pad´e approximation.

4 Mathematical Formulation

Under the definition $\xi = lx + ct$

$$(c + 3lk^3)u' + 4luu' - cl^2u''' = 3l^3u'u'' + l^3uu''', \tag{8}$$

where the prime denotes the derivative with respect to ξ.

The solitary wave solution exists when $0 \leq k < \frac{1}{2}$. Due to the symmetry of the solitons, we consider the wave profile only for $\xi \geq 0$. For simplicity, we choose $c = 1$ and $l = 1$.

4.1 Single Peakon Solution

Let us consider the first case that the first derivative at crest of the solitary waves has not continuity, corresponding to k = 0. In this special case, Eq.(8)reads

$$cu' + 4luu' - cl^2u''' = 3l^3u'u'' + l^3uu''', \tag{9}$$

The corresponding boundary conditions are

$$u(0) = 1, u(+\infty) = 0. \tag{10}$$

It should be emphasized that the boundary condition $u'(0) = 0$ is invalid now. However, the derivative at crest of the solitary waves from right hand exist, namely, $u'_+(0), u''_+(0), \ldots, u^{(n)}_+(0)$ exist. Lundmark [15] showed that the solitary waves with discontinuity at crest exist in the case of $k = 0$, and the corresponding exact solution is

$$u(\xi) = e^{-|\xi|}. \tag{11}$$

The transformed version of Eq.(9) is in following form

$$\begin{aligned}
&(j+1)\,U(j+1) + 4\sum_{i=0}^{j}(j-i+1)\,U(i)\,U(j-i+1) \\
&-(j+3)(j+2)(j+1)\,U(j+3) \\
&=3\sum_{i=0}^{j}(j-i+2)(j-i+1)(i+1)\,U(i+1)\,U(j-i+2) \\
&+\sum_{i=0}^{j}(j-i+3)(j-i+2)(j-i+1)\,U(i)\,U(j-i+3).
\end{aligned} \tag{12}$$

The transformed initial conditions is

$$U(0) = 1, \quad U(1) = -1, \quad U(2) = \frac{1}{2}. \tag{13}$$

According to Eq.(12) ,following expression values are deduced

$$U(3) = -\frac{1}{6}, U(4) = \frac{1}{24}, U(5) = -\frac{1}{120}, U(6) = \frac{1}{720}, \tag{14}$$

Now, we should determine all of the residual j-th derivations of function $u(x)$, i.e. the coefficients of series solution Eq.(4) respect to x_j . Eq.(13) and Eq.(14) have provided the initial value of the sequence of $U(j)$ for the recurrence formula equation (12). So we

can determine all of the j-th derivatives of function $U(j)$ one by one according to Eq.(12). Substituting these obtained $U(j)$ into (4), we obtained the closed form solution as

$$u(\xi) = \sum_{j=0}^{\infty} U(j)\xi^j = 1 - \xi + \frac{1}{2}\xi^2 - \frac{1}{6}\xi^3 + \frac{1}{24}\xi^4 - \frac{1}{120}\xi^5 + \frac{1}{720}\xi^6 - \ldots = e^{-\xi} \tag{15}$$

Due to the symmetry of the solitons,the solution of Degasperis-Procesi equation for k = 0 is $e^{-|\xi|}$.Obviously, this is an exact solution of Degasperis-Procesi equation for k = 0.The solution is as shown in Fig.1(a).

4.2 Single Soliton Solution

Then let us consider another case of the solitary waves with continuous first derivative at crest, corresponding to $0 < k < \frac{1}{2}$ Assume that the dimensionless wave elevation $u(\xi)$ arrives its maximum at the origin. Obviously, $u(\xi)$ and its derivatives tend to zero as $\xi \to 0$ Besides, due to the continuity, the first derivative of $u(\xi)$ at crest is zero. Thus, the boundary conditions of the solitary waves are

$$u(0) = 1, u'(0) = 0, u(+\infty) = 0 \tag{16}$$

The transformed version of Eq.(8) is in following form

$$\begin{aligned} &\left(1+3k^3\right)(j+1)U(j+1) + 4\sum_{i=0}^{j} U(i)(j-i+1)U(j-i+1) \\ &-(j+3)(j+2)(j+1)U(j+3) = 3\sum_{i=0}^{j}(i+1)U(i+1) \\ &(j-i+2)(j-i+1)U(j-i+2) + \sum_{i=0}^{j} U(i)(j-i+3) \\ &\quad (j-i+2)(j-i+1)U(j-i+3). \end{aligned} \tag{17}$$

The transformed initial conditions is

$$U(0) = 1, \quad U(1) = 0, \quad U(2) = -\frac{1}{4}. \tag{18}$$

According to Eq.(17), following expression values are deduced ,for k= 1/4

$$U(3) = 0, U(4) = -\frac{419}{6144}, U(5) = 0, U(6) = -\frac{57461}{4718592} \tag{19}$$

The 9th-order approximation

$$u_9(\xi) = 1 - \frac{1}{4}\xi^2 - \frac{419}{6144}\xi^4 - \frac{57461}{4718592}\xi^6 - \frac{88775935}{33822867456}\xi^8 \quad (20)$$

The 15th-order approximation

$$\begin{aligned} u_{15}(\xi) = & \frac{1}{4}\xi^2 - \frac{419}{6144}\xi^4 - \frac{57461}{4718592}\xi^6 - \frac{88775935}{33822867456}\xi^8 \\ & - \frac{54361734649}{77927886618624}\xi^{10} - \frac{269366582616587}{1316669572308271104}\xi^{12} \\ & - \frac{149777072146377541}{2359471873576421818368}\xi^{14} \end{aligned} \quad (21)$$

The [1, 4] D-P approximation for both (20) and (21) we get is the same,that is,

$$u_{[1,4]}(\xi) = \frac{1}{\left(1 + \frac{1}{4}\xi^2 + \frac{803}{6144}\xi^4\right)} \quad (22)$$

The wave profile is as shown in Fig.1(b). It is easy to see that our analytic solution converges. Differential transform-Pad´e approximation is an effective method to accelerate the convergence of the result and enlarge the convergence field.Thus Differential transform-Pad´e approximation achieves a high convergence rate over a considerably large convergence region.

5 Discussions and Conclusions

In this paper, the differential transform method is applied to obtain the analytic solution of the solitary waves governed by Degasperis-Procesi equation. Analytic solutions are obtained for solitary waves with and without continuity at crest. This provides us with a new analytic way to solve solitary wave problems with discontinuity. The present study has confirmed that the differential transform method offers great advantages of straightforward applicability, computational efficiency and high accuracy.

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Approach to IT Innovation Concept Network Based on Analysis of Discourse

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Abstract. Innovation Concept is an abstract or generalized innovation idea which always encourages and pushes forward material/service innovation. A concept diffuses through social actors' communication or discourse. Plus, there are always some sets of core concepts that dominate the agenda for research and practice as a field progresses that set evolves, with new concepts replacing old ones. Therefore, the sets of concepts, the relationship among those concepts and the evolution of concepts, all of them constitute the concept network. This paper will focus Information Technology as an exemplar field, leveraging the broad and accessible discourse on that topic found in vast collections of formal and informal sources. Text analytic techniques from information retrieval and computational linguistics will be adapted to detect specific concepts and to understand why those innovation concepts are popular in concept network and how they work well.

Keywords: Innovation concept, Analysis of discourse, Innovation network, Innovation concept evolution.

1 Introduction

Since a concept is an abstract or generalized idea, innovation concept is an abstract or generalized innovation idea. Rogers[3] defined an innovation as "an idea, practice, or object that is perceived as new by an individual or other units of adoption". Actually, both idea and material compose the innovation life cycle. Innovation idea is the soul and motive force of the material innovation.

In any technology field, there is always some set of core concepts that dominate the agenda for research and practice, especially in Information Technology(IT) field. Wang[1] found similar competitive relationships among five IT concepts, except that, paradoxically, the popularity of ERP increasingly positively correlated with the popularity of business process reengineering (BPR), a closely related concept to ERP. While this reinforcing relationship contradicts the principle of competitive exclusion, it confirms a main thesis in social cognition theory. When a particular concept is activated, related concepts may be activated as well[2]. Given the significance of technological innovations in our economy and society and the important functions technological concepts play in shaping the diffusion of the innovation products and services, the diffusion of these concepts themselves warrants more research. In this dynamic micro-macro diffusion process, many questions remain unanswered: For any

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technology field at any one time, what are the current concepts? What are the relationships among the current concepts in their contents? For each concept, who are interested in the concept? Who are opinion leaders? How popular is the concept? Over time, what concepts are becoming more popular? What concepts' popularity is dwindling? How do the relationships among concepts change, resulting in converging or diverging thrust areas? Does the popularity of a concept in discourse correspond to the popularity of the products and services in marketplace? Taken as a whole, these questions motivate us to undertake this research to describe, explain, and predict the diffusion of technological concepts. In IT field, we are always inspired by an overarching question: Why are some innovations adopted widely and quickly but not others? But the current most of researchers always focus on innovation product or innovation technology, whereas the lack of attention to Idea innovation.

In this paper, we will discuss what is IT Innovation and innovation diffusion, and how the IT innovation concepts diffuse with computational analysis of discourse. In the section 2 and section 3, we will discuss what are IT innovation concepts, innovation network and innovation diffusion. In section 4, we will discuss how to analyse the data from the vast literatures. In the last section, we will analyse the result of data processing.

2 Issues on Innovation Concept and Innovation Diffusion

Most innovations have two forms: idea and material [3]. The material form of an innovation consists of product innovation and service innovation usually. The idea form of an innovation is the set of information used to describe the innovation and evaluate its consequences. For example, the idea underlying the CC(Cloud Computing) innovation is that software applications in various functions of an organization should be integrated into one system and that this integration reduces the cost of information processing. In contrast, the material form of an innovation refers to the existence of the innovation in the physical world, often as artifacts and practices. Continuing the previous example, the material form of the CC innovation includes the CC software that organizations purchase from CC vendors, the computer and network hardware on which the CC software is installed, activities to maintain and upgrade CC product, and so on.

An innovation idea, as a form of information and knowledge, is qualitatively different from innovation materials in at least two ways. For one, ideas are much less tangible than materials. For another, one idea can be shared by an infinite number of people and organizations, whereas each material item can belong to only a finite number of owners.

The diffusion of any innovation is actually the diffusion of the innovation in both the idea and material forms. Adopters of CC, for example, have adopted both the CC idea and the CC hardware, software, and practice. Because of the differences between ideas and materials, researchers have long suspected that the diffusion of ideas and the diffusion of materials are fundamentally different. Diffusion of Innovation research thus far has not made a clear distinction between these two forms of innovation. As the knowledge economy and society continue growing, people and organizations often know significantly more than what they do [4].

Ideas travel and spread through discourse among people and organizations in their social networks. Social actors exchange ideas by engaging in discourse, i.e., talking, writing, listening, and reading, via discourse outlets including advertisements, books, magazine articles, conference speeches, training materials, brochures, interview scripts, roundtable discussions, blogs, and so on [5].

The idea form of an innovation, when it is generalized across the social worlds, can serve as a boundary object that provides these diverse social worlds with a common framework for understanding and discussing an innovation. Diffusion of ideas, as a form of knowledge, is rapidly outpacing the diffusion of material products and services. Hence, the diffusion of innovation ideas warrants serious research attention.

It is hard to obtain and compute innovation idea from something of material-type, but we can get concepts from literature with text analysis method. A concept is a generalized idea. A technological concept is a generalized idea about the development and use of a technological innovation. Concepts abound in every technology field, such as gene splicing in biotechnology, CC in information technology. These examples imply that each concept represents a set of specific ideas about each innovation: what the innovation is, how it works, and what benefits or risks it brings and that at least one unique term is associated with each concept as the label for identifying the concept in the discourse.

3 Innovation Networks

Our world is made up of networks of innovations. An innovation network is a set of innovations that are interrelated with each other. Innovations are related in many ways. First, a broader innovation may be comprised of narrower, more specific innovations. For example, wiki and blog are specific innovations that epitomize the more general innovation Web 2.0. A special case of this type of relationship is the distinction between the conceptual form of an innovation and the material form of an innovation. The conceptual form of an innovation is the set of ideas and information used to describe the innovation and evaluate its consequences. For example, the idea underlying the Web services innovation is that computing is delivered as services over the Web.

Second, innovations may be related because they represent the same core idea. For example, both cloud computing and utility computing are based on the idea that computing is provided as a public utility, despite the fact that cloud computing is more recent and more specific about Web delivery.

Third, although the relationship between cloud and utility computing may suggest a simple transition from the old to the new, innovations may compete with each other. On the one hand, different expressions of the same underlying idea may compete.

As innovations are interrelated in a network, their evolutionary trajectories (including their popularities and capabilities) are interrelated too. It may be helpful to conceptualize networks of innovations as part of an ecological system, where innovations can be likened to species in a competitive and symbiotic resource space. Just like an arctic fox subsisting upon guillemot eggs and remains of seals killed by polar bears, innovations rely on the attention and money that people and organizations invest in their development and use.

As resources flow through an innovation network, the popularity and capability of every innovation in the network changes over time. However, findings from the few previous studies on the relationship among innovations are inconsistent at best, and thus it is problematic to generalize from these studies.

4 Analysis of Discourse for Innovation Concept Network

IT innovation concepts and the relationship among those concept in a same set change over time. In order to make innovation concepts works well, we should know how to analyze the innovation concepts and the relationship among of those concepts. In this section, we will discuss how to compute and analyze the cluster relationship among of those concepts and the popularity of them.

A. Data Collection

There are numerous discourse outlets, including books, magazines, conferences, blogs, wikis, and many others. Specifically, we downloaded all of the articles about IT innovation concepts published during an eleven-year period (1999-2008) from CNKI database. Journals in CNKI website were used as an exemplar outlet of the IT innovation discourse. Meanwhile, we compiled a list of 10 IT innovation concepts (Table 1). This list illustrates a broad range of IT innovation concepts in the examination period. We then extracted from the resource articles all the paragraphs containing any of IT innovations on the list. In doing so, we considered various labels for the innovations, plural forms, and acronyms unique to the innovations. Some IT innovations had many paragraphs in the 10-year period while others have only a few. For example, there were more than 2,000 paragraphs mentioning Enterprise Resource Planning (ERP). In total, more than 3,500 paragraphs containing any of the 10 IT innovations were extracted from CNKI.

Table 1. List of IT Innovation Concepts

RP	Enterprise Rresource Planning
CRM	Customer Relation Management
SCM	Supply Chain Management
SOA	Service-Oriented Architecture
RFID	Radio Frequency Identification
SaaS	Software-as-a-service
CC	Cloud Computing
BI	Business Intelligence
BPO	Business Process Outsourcing
Web2.0	Web2.0

B. Algorithm of Concepts Analysis

Discourse analysis of innovation concepts presently faces a methodological challenge: Discourse data are often voluminous and very labor-intensive to collect and analyze. Extant discourse studies of innovation concepts have to trade off between case studies

using in-depth data and large-scale analysis using thin observations. Recent advances in computational analysis of discourse have made it possible to achieve both depth and breadth in discourse analysis. Computational or automated analysis of discourse is a large, active interdisciplinary field with a variety of theories and techniques. To demonstrate the utility of computational discourse analysis, we have chosen one technique suitable for our interest in the emergence, coexistence, co-evolution, and relationships of innovation concepts. This technique, called Kullback-Leibler (KL) divergence[6], is essentially a measure that quantifies how close a probability distribution P is to another distribution Q. For probability distributions P and Q of a discrete random variable, the KL divergence of Q from P is defined to be $D_{KL}(P\|Q)=\sum_i P(i)\log\frac{P(i)}{Q(i)}$. KL divergence is commonly used for comparing the relative frequency of term use in pairs of discourses. Before we detail our use of this technique in this illustrative empirical study, we need to describe the discourse data we collected.

According KL divergence formula, we design and make a program as following with Matlab:

```
function dist=KLDiv(P,Q)
  if size(P,2)~=size(Q,2)
        error('the number of columns in P and Q should be the same');
  end
  if sum(~isfinite(P(:))) + sum(~isfinite(Q(:)))
      error('the inputs contain non-finite values!')
  end
  % normalizing the P and Q
      Q = Q ./repmat(sum(Q,2),[1 size(Q,2)]);
      P = P ./repmat(sum(P,2),[1 size(P,2)]);
      temp =  P.*log(P./Q);
   temp(isnan(temp))=0;  % resolving the case when P(i)==0
    dist = sum(temp,2);
end
```

C. Data Analysis

In the above dataset, each innovation is represented by the paragraphs mentioning the innovation. The use of language in those paragraphs constitutes a probability distribution over words, and we calculated the symmetrized KL divergence for each pair of innovations. The calculation generates an asymmetric 10*10 matrix with each column and row representing one of the 48 innovations. After symmetrization (by averaging the KL divergence in each direction), values in the matrix can be considered as a distance between each pair of innovations.

In order to visualize the distances between innovations in a two-dimensional space, we applied multidimensional scaling (MDS) to the symmetrized KL divergence matrix. MDS is a set of statistical techniques for information visualization. Based upon a matrix of item-item similarities or dissimilarities, an MDS algorithm assigns a location to each item in a space such that the distances the items correspond as closely as possible to the measured dissimilarities between the items. In other words, the proximity of items to each other on the space indicates how similar they are. In MDS, one can choose the number of dimensions s/he wants the algorithm to create.

Generally, the more dimensions, the better the statistical fit, but the more difficult it is to interpret the results.

MDS has an advantage over other dimension-reduction techniques such as factor analysis because MDS can fit an appropriate model in fewer dimensions than other techniques. In addition, a matrix of symmetrized KL divergence measures is appropriate input for MDS but not for factor analysis. Further, MDS allows researchers to gain insights into the underlying structure of relations between items by providing a geometrical representation of the relations [7]. We used the MDS procedure in SPSS based on the ALSCAL or alternating least squares scaling [8], the most popular algorithm in MDS. For simplicity, we chose two dimensions so that the 10 IT innovations can be presented in a two-dimensional scatter plot, in which the proximity of innovations indicates similarity.

5 Result Analysis

Figure 1 is the MDS plot of the 10 innovations, with an R-squared of 0.75, suggesting that 75% of the variance of the scaled data can be accounted for by the MDS procedure. To interpret this MDS plot, we followed[9] to draw closed contours around the items that we consider closely related innovations based on the locations of the items and our own knowledge of the innovations. The areas so enclosed represent regions of relatively high density, and the extent of their dissociation is the distance in a MDS configuration [9]. For illustration, in Figure 1 we have identified five groups, which we describe in detail below. Figure 1. MDS Plot of the 10 IT Innovations from 11-year CNKI Data.

Fig. 1. MDS Plot of the 10 IT Innovations from 11-year

Group 1 includes Cloud Computing (CC) and Software as a Service(SaaS). The popularity curves of the two innovations in Figure 3 indicate that both were coming up popularity throughout the examination window. As these innovations have become institutionalized as a taken-for-granted practice in IT field, there is ascending need to discuss them in the discourse, hence the ascending popularity for both.

We counted the number of paragraphs each year containing the innovation concepts in Group 1 and Figure 2 shows the popularity curves of these innovations. The number of paragraphs about an innovation indicates the prevalence or popularity of the innovation in the discourse. Interestingly, concepts in this group followed similar popularity patterns: they all had a significant surge around 2006 and 2007. This finding seems to suggest that that items close to each other in a MDS plot tend to follow similar popularity patterns in discourse.

Group 2 includes CRM,ERP and SCM. Apparently, they seem to belong to the ERP family broadly defined. Hence we named this group as ERP. Those concept are more popular year by year, but ERP is the best one for use in marketplace.

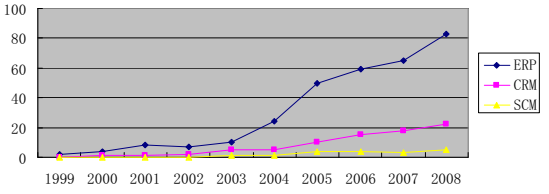

Fig. 2. Paragraph Count of Concepts in Group 1

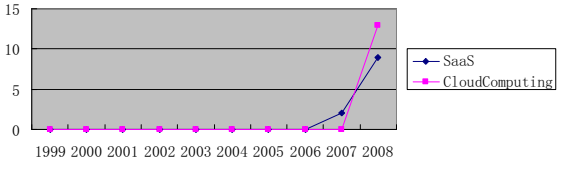

Fig. 3. Paragraph Count of Concepts in Group 2

6 Conclusion

The result from the KL-divergence and MDS analysis apparently demonstrate that innovations with similar contents and/or intrinsic relationships are closely located in the two-dimensional spatial representation of the linguistic patterns in the discourses. While this result is unsurprising to anyone with at least basic familiarity with the innovations, the finding provides reasonable confidence in the internal validity of the study's computational approach to discourse analysis.

Anyway, this research based on computational analysis of discourse gives us a good way to explore idea innovation diffusion which will be helpful to understand how and what lead to innovation.

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Study on the Evaluation Index System of Biotechnology in Industry

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Abstract. Evaluation index system is not only the basis of evaluation but also the evidences of comprehensive reflection for the development of the biotechnology industry. This article researches on its evaluation index system from a combination of the macro level and micro level in the biotechnology industry. Through the principle of the evaluation index system in biotechnology industry, constructing four indicators such as the environment indicator、power indicator、resource indicator、economy indicator and system model of evaluation index system of the biotechnology industry. By a research object of Pharmaceutical Manufacturing data, calculating the main impact factors of biological industry development in China and the contribution rate of the biotechnology industry in the different stages.

Keywords: Biotechnology, Bioindustry, Evaluation Index, System, Model.

1 Principles Established by Evaluation Indicator System

The process of cognition and decision making how people look at certain criteria to judge and compare the values and relative merits of the object is called evaluation. Evaluation indicator system is a scientific, complete, actual, and reasonable totality, which is made up of a series of indicators that are interrelated and restricted. Basically, it can be accepted by relevant departments and personnel. Therefore, the evaluation indicator system of biotechnology industry should follow the principles below:

1.1 Theoretical

Some theoretical requests existing are the precondition to design any evaluation indicator system. Only when it is under the guidance of developmental theory of biotechnology industry can the evaluation indicator system be designed.

1.2 Multi-objective

Serving certain specific purpose is the basis to design any evaluation indicator system. The evaluation of biotechnology industry involves many aspects, and it cannot be

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completed with only one or two indicators. There needs to establish an indicator system to represent the development of biotechnology industry multi-directionally, multi-dimensionally, reflecting the developmental level on the whole. The evaluation indicators of biotechnology industry are multi-element, including the elements of social economy, moral culture, and ecological environment that can affect the biotechnology industry. It must meet the above requirements and objectives to design the evaluation indicator system of biotechnology industry.

1.3 Systematic

It should be specified that the design indicator has its internal relations and large scale system that has various levels. Meanwhile, the selection to any indicator should be included in this system. From the angle of systematology, the requirements to the evaluation indicator system of regional biotechnology industry are embodied in the aspects below: the first one is wholeness. The three dimensionalities to sustainable development, that is the three-dimensional integration from society, economy, ecological environment, can be taken into account. The development of biotechnology industry is a complicated large scale system, and the orderly operation of subsystems is the basis for large scale system to exert its overall function. However, the comprehensive purposes of large scale system that is optimal are the developmental objective to subsystems. Therefore, the biotechnology industry should take the large scale system that has a lot of element into an overall consideration. The second is hierarchy. The development of biotechnology industry has a distinct hierarchy. From the global total system, different levels and regions successively become its subsystems, made up of different attributions and elements. From the aspect of a specific region, it is made up of subsystems of economy, society, ecological environment. And the subsystem economy can be divided into three industries and divided into three subsystems. Indicator system should make an evaluation summary by distinguishing different levels. The third is dynamicness. Biotechnology industry is a new industry that has uncertainty and a great development potential, and its dynamicness to decide the evaluation indicator system is not stable. The fourth is periodicity. Its evaluation indicator system should have phasic characteristics. During the growth stage and maturity stage of development of biotechnology industry, their evaluation indicators are different or there is difference along the evaluation methods.

1.4 Scientificalness

Scientificalness is embodied in the theoretical direction after the test of practice and corresponded with objective requirement. While selecting the indicator to analyze, it should not only take the funds and other elements into consideration, but also the point of view to the intellectual activity that the subject of biotechnology industry is human being. The indicator can be chose through comprehensive similarities and extensive consensus according to the characteristics of biotechnology industry, and the indicator should be of rationality and representativeness.

1.5 Operability

The current statistical system should be taken into account, and the indicator should have the basis of statistical calculation. It increases the difficulty to establish the national innovation evaluation indicator system of biotechnology industry since the statistical indicator system of biotechnology industry has not been confirmed yet. The relations between ideal indicator and actual indicator should be handled. For instance, what is the intension and extension of intellectual capital? What is the content of intellectual capital about statistical significance? It has not involved yet and there is no operability in system. Some indicators can also choose alternative ones that have similar implication. The difference between innovation evaluation indicator and indicator analytic method should be distinguished. Innovation evaluation indicator takes the national innovation evaluation indicator into account from the macro level of biotechnology industry, establishing the national innovation model of biotechnology industry so as to find the numerous factors that have an influence on biotechnology industry from the description and evaluation of the speed of development, scale, structure, quality, and the national economic growth and contribution of biotechnology industry. However, the indicator analytic method provides the quantitative analysis tools to the national innovation evaluation indicator system of biotechnology industry that it is the basis to establish innovation evaluation indicator system and conduct analytical investigation.

1.6 Comparability

The confirmation of indicator should be convenient to compare with foreign countries, domestic enterprises, large and small enterprises, and the dynamic comparability of the enterprise itself. The key point of innovation evaluation indicator should stand out and it should be as simple as possible so that it can be continuously consummate after the country ensures the statistical indicator system of biotechnology industry.

2 The Content of Evaluation Indicator System of Biotechnology Industry

2.1 Environmental Evaluation Indicator of Biotechnology Industry

Natural ecological environment includes two indicators that the influence made on biodiversity by bioenergy and the influence made on biodiversity by transgenic technology products[1].

Humanistic ethical environment includes two indicators that the influence made on human ecological environment by stem cell technology and the influence made on human ecological environment by cloning technology products[2].

2.2 Dynamic Evaluation Indicator of Biotechnology Industry

Policy guarantee includes two indicators that the proportion of funds for research input into bioindustry by the government with its annual growth rate and the tax deduction made by the governments at all levels with its annual growth rate.

Institutional innovation includes the following indicators of stock system of biological enterprises and the proportion of non-state enterprises. The proportion of funds for research enterprise occupies in bioindustry. Thereinto, 70% around is good, 65% above is better, 60% around is ordinary, 50% around is bad. The number of small-scale biotechnology companies, and private science and technology development institutions that is newly increased each year. The year-on-year growth rate of funds of biotechnological research and development in colleges and universities and research institutions from enterprises that occupies the funds proportion of total R&D in biotechnologies.

Incentive mechanism includes the equivalent growth rate of returnees each year, and the annual growth rate of national grade of scientific and technical prizes about biotechnology research.

Market foundation includes dweller consumption level, the gap between imports and exports of genetically modified product, the proportion and annual growth rate of bioenergy occupying in the total energy consumption.

Biology Service The annual growth rate of CRO and other biology services and the number of service firms of bioindustries in biological science and technology park.

2.3 Resources Evaluation Indicator of Biotechnology Industry

Human resource includes the personnel engaged in R&D of bioindustry that occupies the proportion employees engaged in bioindustry, the number of scientific and technical personnel for every one million (scientists and engineers) and the comparison to the international status, the annual growth rate of the high rate of output of biologists and the comparison to the international status, the annual growth rate of talented person engaged in basic and applied bioscience and the comparison to the international status, the annual growth rate of talented person engaged in bioindustrial engineering development and the comparison to the international status, the annual growth rate of various senior management talents and inter-disciplinary talents and the comparison to the international status.

Physical resource includes the demand rate of state key laboratory and technology platform of bioindustry to life science and biological technology research and development, the annual growth rate of original instrument and equipment cost of R&D institution in bioindustry, the implementation of scoring system evaluation of technical standard system in bioindustry, the number of the nationwide market of technologies, the number of nationwide innovation service centers in science and technology park, the level of pilot plants along biological technology achievements.

Financial resources includes the proportion of financial funds to the amount of science and technology campaign funds; the proportion of loans to financial institutions to the amount of science and technology campaign funds; the proportion of risk investment invested into biological industrial R&D and industrialization; the R&D intensity (the proportion of total R&D funds to GDP); thereinto, 2.5% above is good, 2% above is better, 1% above is ordinary, 1% below is bad; the proportion of corporate R&D to corporate sales revenue and its comparison to the international status; the proportion of corporate non-R&D to sales revenue, including the cost he total cost to new product engineering preparation and pilot production, and the total cost and the proportion to the cost of producing new products and applying new techniques, and the

test marketing cost of new products to the sales revenue; the proportion of the total funds on research and development applied in bioindustry, thereinto, 40% above is good; 30% above is better, 20% above is ordinary, 20% below is bad.

Technology resources include the quantity of papers in life science and biotechnology and their international status; the annual growth rate of the quantity of patent approvals of biological technology achievements classified according to international patent standard, and the patent application and authorization of bioeconomy; the transformation rate and growth rate of biological technology achievements; the new strength made through introducing technologies for digestive absorption and the proportion of funds made through introducing for technologies for digestive absorption and the cost of introducing biotechnologies; the growth rate of cost to purchase domestic technologies.

Information resources include the quantity of joint projects of international biological technology and the quantity of libraries owned per ten thousand people.

2.4 Evaluation Indicator of Biological Economic Benefit

Economic benefit includes the comparison to the profit and tax per capita in bioindustries and the profit and tax in enterprises; the value-added ratio of overall labor productivity in bioindustries; the proportion between the new product sales revenue and total sales revenue;

Economic growth includes the proportion of bioindustry to GDP; the contribution rate of bioindustry to the growth of GDP; the growth rate of GDP.

International competitiveness includes the proportion and growth rate of value of export in bioindustry to the total value of export in the whole nation; the proportion of export sales revenues to the total sales revenue in bioindustry.

Social progress includes average life span and the growth compared; the quantity of employment and its annual growth rate in bioindustry; the contribution to environmental quality; the proportion of growth rate of disposable income per capita to the total in bioindustry; the level of education to employees in bioindustry and the location.

Optimize structure includes the proportion of primary, secondary and tertiary industries in biotechnology industry, and the proportion of bioindustry to other high-tech industries and the comparison to the condition of growth rate.

3 System Model Establishment and Empirical Analysis to the Evaluation Indicator System of Biotechnology Industry

3.1 System Model Establishment to the Evaluation Indicator System of Biotechnology Industry

This model can be summarized as four elements: the development environment which is development premise is the environmental factor to development; development power that is the driving force to development; development resources that are the basic factors to development; development benefits output that is the comprehensive efficiency factor and to check the achievement of development. There are three

processes: the development environment translates development premise into development power, the development power is translated into development resources, and development resources create development benefits output. The new innovation power of creative feedback system is made from the process of marketization of technical innovations and the benefits gained from technical innovations. This circulatory system forms the basic innovation model for the nation, and also forms the basis to the development of bioeconomy.

System model to the evaluation indicator system of biotechnology industry.

3.2 Empirical Analysis

According to system model to the evaluation indicator system of biotechnology industry, the environmental benefits model can be established. Environmental security is the premise for a country to make industrial policies. Power resource model: it relies on the state industrial policies, tax revenue and various financing support policies to play the function of resource. Resources benefit model: it is the most significant model, which determines the level of technological innovation and industrialization of the development for bioindustry, is the basis to develop biotechnology. Therefore, it gives the selective analysis and empirical analysis to the establishment of this model. Because of it that the bioindustry is an emerging industry and it is limited by statistical data and information. This paper uses apply the data of pharmaceutical industry as the object of research to measure the major factors that influence the development of bioindustry in our country, and the contribution rate in different periods.

3.2.1 Linear Model of Resource Effectiveness

$$LogY = C + C_1 LogX_1 + C_2 LogX_2 + C_3 LogX_3$$

Y output value of pharmaceutical industry ;

X_1 scientific and technical personnel ;

X_2 science and technology cost ;

X_3 patent ;

C_1、C_2、C_3 estimated parameters。

Here needs some descriptions to the quantity of patents. The reason why I chose the quantity as the factor to the sample of technical economic achievement is that patent is often used as the means to evaluate the science and technology outputs of technical innovation. In addition, patent is more standard in the statistical reporting, and the data are more comprehensive.

Because of the limitation of collecting data, the development situation of pharmaceutical industry over the last 9 years is planned to be chosen, and operated with weighted least square method on Eviews software, the estimated results below:

Dependent Variable: LY
Method: Least Squares
Date: 09/14/10 Time: 10:33
Sample: 2000 2008
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.566751	2.736976	-0.937805	0.3914
LX1	1.444458	0.740200	1.951442	0.1085
LX2	0.365228	0.140200	2.605054	0.0480
LX3	0.205673	0.064948	3.166706	0.0249

R-squared	0.997990	Mean dependent var	7.141962
Adjusted R-squared	0.996784	S.D. dependent var	0.521716
S.E. of regression	0.029587	Akaike info criterion	-3.901832
Sum squared resid	0.004377	Schwarz criterion	-3.814176
Log likelihood	21.55824	F-statistic	827.4623
Durbin-Watson stat	3.071089	Prob(F-statistic)	0.000000

It can be seen from the estimated results above that the output value of pharmaceutical industry, scientific and technical personnel, cost of scientific research, scientific and technological achievements (patents) are in a strict positive correlation, the degree of correlation is 0.99. The coefficients of X_1, X_1, X_1 applied have passed the X_1 test, and the X_1 test is more remarkable.

Table 1. Pharmaceutical manufacturing development situation

Pharmaceutical manufacturing	Production added value (million)	Staff (Ten thousand)	R&D (million)	Patents
2000	634	99	19.9	547
2001	722	103	19.3	735
2002	835	106	21.6	999
2003	1025	115	27.7	1305
2004	1173	115	28.2	1696
2005	1530	123	40.0	2708
2006	1808	130	52.6	2383
2007	2287	137	65.9	3056
2008	2831	147	79.1	3917

Data sources： Science and technology of China statistics nets

Compared to the coefficients of three factors, it can be seen that the scientific and technical personnel and resources of human talents have a significant effect on pharmaceutical industry. There can be 1.44% more output value from pharmaceutical products by 1% additional scientific and technical personnel. Then, it is financial resource. There can be 0.37% more output value from pharmaceutical products by 1% additional capital investment. The smallest is patent. There can be 0.21% more output value from pharmaceutical products by 1% additional patents.

It can be seen from the analysis of mathematical model of pharmaceutical industry that the resources of human talents of bioindustry in our country very abundant, but the contribution rate of financial resource and technical resources is small. Especially, the aspects of achievement transformation and industrialization still need to be improved.

3.2.2 Discussion of Contribution Rate about Three Factors on Pharmaceutical Industry in Different Phases

$$Y = AX_1^{\alpha} X_2^{\beta} X_3^{\gamma}$$

Variables as above

All derivative of T

$$\frac{dy}{dt} = \frac{\partial y}{\partial t} + \frac{\partial y dx_1}{\partial x_1 dt} + \frac{\partial y dx_2}{\partial x_2 dt} + \frac{\partial y dx_3}{\partial x_3 dt}$$

Divided by y：

$$\frac{y'}{y} = \delta + \frac{\alpha x_1'}{x_1} + \frac{\beta x_2'}{x_2} + \frac{\gamma x_3'}{x_3}$$

Table 2. Each factor to the output growth contribution in different stage

Year	C_1	C_2	C_3	δ
2000-2008	23.7%	49.3%	12.1%	18.2%
2000-2004	20.8%	66.5%	9.6%	16.7%
2004-2008	26.4%	35.2%	13.9%	24.5%

Assume that the relations of output value of pharmaceutical industry, scientific and technical personnel, science and technology cost, and patent obey the Cobb-Douglas function.

The research and analysis are made below according to the three (for data, see the table above) phases. First, we analyze the contribution characteristics in these three phases:

(1) During the years of 2000 to 2004, the input funds of scientific research (fund factor) is the most significant factor on pharmaceutical industry, the next is the quantity of scientific and technical personnel (talents factor), the weakest is the quantity of patents (technical economic factors);

（2） During the years of 2004 to 2008, at the first phase, the development tendency of contribution made a remarkable change. The advance of science and technology made a remarkable improvement on efficiency, and patent was still the weakest factor on contribution. From the above two phases of contribution characteristics, we can conclude below:

①At the initial stage of development (2000-2004), the most significant factor bioindustry had was fund because any industry needs funds to input at the initial stage. According to the high-input characteristics of bioeconomy, it is the same to the development of bioindustry. There needs a great quantity of funds from various channels to input to scientific research to have plenty of achievements in biotechnology. Second, from the aspect of industrialization, achievements in scientific research should be translated into commodities so as to have a large-scale production, with purchasing some equipments and raw materials, etc. The fixed assets acquired and

the necessary basic construction done caused a big financing gap. Therefore, each sum of reasonable expense in this phase will push the process of industrialization, reflecting on the added output value bioindustry. Because of its small-scale industrialization in the beginning with a great demand for fund, the talent treatment is hard to promote, and its demand gap for talents is not that big in this phase. Therefore, it only reflects a medium influence on the contribution of bioindustry, and patent has the weakest influence.

② After the biotechnology industry develops into a certain scale, the factor to improve the efficiency is more remarkable, and talents make a increasingly greater influence on biotechnology industry. On the one hand, there is an increase in demand for varieties of professional technicians because of the enlarging scale of industrialization. On the other hand, the development of bioindustry makes a regular benefit so that it is equipped with the conditions to attract talents and improve talent treatment, drawing more scientific and technological elites into the group of bioindustry. The highly qualified, large-scale intellectual resources push forward the bioindustry to speed up development. And at this point, the demand for fund tend to be mitigant. Compared to the early time, it is not that urgent, and there is a certain relationship to the situation that the fixed assets and equipments applied to industrialization can make a long-term application. On the other hand, when the biotechnology industry develops into a certain phase, it has a larger and higher requirement to the achievements and qualities in scientific research. It reflects that the contribution the quantity of patents makes to the output value of bioindustry is increasing. However, there is a certain relationship to the hysteresis quality of the commercialization of research findings to commodities. It means that the later factor on contribution contains the transformation contribution that the previous scientific and technological achievements made to the output value of bioindustry.

It can be seen from the above analysis and conclusions that we must take into account that the constraints and characteristics along different development phases are not the same while making policies and measures to promote the development of bioindustry. We should take relevant measures to push forward the bioindustry to speed up its development according to the regular patterns and characteristics in the development phases.

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On the Basis of Science and Technology in Bioindustry

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Abstract. Since 1990s , bioscience and biotechnology which have made breakthrough have laid the foundation on the original innovation of biotechnology.The fourth science and technological revolution is forming , which focus on biotechnology.The development of biosicience and biotechnology lay the solid foundation for the production of bioindustry. It promotes the rapid rise of bioindustry which produces bio-technology products and provide bio-services that biosicience discovery and biotechnology that biosicience making new discovery and biotechnology making new breakthrough.

Keywords: bioscience, biotechnology, bioindustry.

1 Scientific Basis for the Formation of Bio-industry

1.1 Implications of Life Sciences

Life science is a comprehensive basic discipline to study the origin of life and the basic substances of its formation as well as its motion laws. It has evolved from a static discipline focused on morphological description and analysis into dynamic discipline based on the experiments and quantitative analysis. Current life science is moving from analysis to comprehensiveness, which is characterized on the full-range integrated studies on molecules, cells, tissues, organs.

1.2 Progress of Life Sciences

The scientist Land in MIT said: "The human genome project is best understood as similar to the discovery of the periodic table in 20th century. The goal of the human genome project is to produce a biological ' periodic table '. It doesn't have hundreds of elements, but 100,000 genes. It is not a rectangular form that reflects electron valence bond, but a tree structure that reflects the close contact between the gene and the functions of human genes.”。 More than 100 years ago, no one knows what a gene is, what the basic group is, and what the chromosome is. Charles Darwin, the founder of biology, described the outline of the origin and evolution of life in his book “Origin of Species” published in 1859. Mendel's published the report of peas hybrid experiment in 1866, revealing the classical inheritance law; in 1902, Sotton and Boveri officially proposed the chromosome theory, in 1909; Johannsen defined the genetic factor as

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"gene" [1]. In 1910, Morgan discovered the law of linkage and the law of exchange, which make up for the hereditary feature that cannot be explained by the law of separation and the Law of Independent Assortment. The three genetic laws discovered by Mendel and Morgan have become the foundation for the study of human life science. Watson and Crick discovered the double helical structure of DNA molecules in 1953, which clarified the mechanism of inheritance from the molecular level, laid the foundation for modern molecular biology, and became a milestone in the history of the life sciences. In 1957, Crick proposed the genetic information transfer routes which became known as the "central dogma". Grhen isolated the first gene outside the human body in 1973, which has a revolutionary impact on many branches of the life sciences. The scientific communities worldwide jointly implemented the "the human genome project", and they announced the completion of working draft of human genome on June 26, 2000, which became the third milestone in the history of human science and technology after atomic bomb and the man on the Moon. The rapid development of information technology has penetrated in the field of life sciences, and developed into bioinformatics with a wide range of uses. At present, functional genomics, proteomics and metabonomics have become the mainstream of the development of life sciences [2].

Along with the completion of complete sequence determination of more than 50 species of human genome, the result showed that the number of human genes is much less than expected 100,000. It is actually 30,000 or so, and the result "decrypted" a number of chromosomes. But the number of genes with known function is less than half of them. Genomics research just began after the completion of genomics sequencing. Humans has entered the post (functional) genomic era in the 21st century, which made biology research switch from gene or protein research into systematic research on multiple genes or proteins at the same time. The functional genomics research is based on genomic sequences. Proteomics is a more complex study. Genes are the carriers of genetic information, and the implementation of biological functions depends on protein [3]. It's not enough to study life only from the genetic perspective. The life activity patterns can only be revealed by studying the process of gene transcription and protein translation. A gene is not only corresponding to a protein. It may be several or even dozens of proteins. How to express these proteins? They are controlled by what factors? How to exercise their functions? These issues can not be solved only by genome research. Protein has its own unique activity patterns. The great diversity and dynamic changes of intracellular protein composition is not easily reflected on the genomic level. In this context, Proteomics as the study the proteins within the cell and its activities was born [4]. Complete and accurate three-dimensional structure determination of biological macromolecules and their composites and assemblies is the scientific basis for revealing the physical sand chemic nature of life phenomenon. From the perspective of functional genomics, it is widely believed that a disease is related to 10 genes or so, and each gene is associated with 3-10 proteins [5]. In the 21st century, the biomolecular research focused on protein has entered into a new level. For 100 years, scientists from around the world have been searching, locating, separating, operating, developing and utilizing genes, and therefore formed a series of new disciplines and technology industries. 100 years ago, gene was nothing but a hereditary symbol represented by English letters; but only 50 years later, it has been revealed that DNA molecule is the material basis for gene. And 50 years later, the

human genome sequencing has been completed. It is predictable that life sciences will witness one and another amazing miracle in the next 50 years.

2 Technical Bases for the Formation of Bio-industry

2.1 Implications of Biotechnology

Biotechnology is also known as biological engineering. It is a technology based on the life sciences, applies biochemistry, biophysics, cell biology, microbiology, molecular biology, genetics, and other principles with biochemical engineering to research, design and renovate living systems to improve and even create new organisms. It also reconstructs or redesigns cell's genetic material and produces new varieties, which uses the existing biological systems and biochemistry to manufacture biological products and provide services for human. In short, biotechnology is a technology relying on microbes, animals and plants as reactor materials to process materials and provides products to serve the community [6].

2.2 Development of Biotechnology

The earliest use of biotechnology in the world was about 7,000 years ago, when people were already able to conduct crop hybridization successfully. About 1000 years later, people mated female horse and male donkey to produce a new animal species "Mule", which has the strengths of both horses and donkeys. But people at that time didn't know this animal was the first animal generated by genetic engineering in the history of the world. Winemakers and cheese experts who used bacteria and yeast were early biotechnology engineers. Looking at the history of biotechnology, its development can be divided into three distinct phases: Traditional modern biotechnology, biotechnology in recent period and biotechnology in modern times. The technical feature of traditional biotechnology is brewing technology; the technical characteristic of biotechnology in recent periods is the microbial fermentation technology, and the technical feature of modern biotechnology is marked by genetic engineering. According to applications of biotechnology in different areas, people generally divide biotechnology into "red biotechnology (bio-pharmaceutical technology)", "green biotechnology (agriculture and food biotechnology)", "white biotechnology" (industrial and environmental protection bio-technology)[7].

Because bio-products, bio-industries and bio-economy are built up on the basis of biotechnology, So the clarification of the concept of biotechnology is a prerequisite for research on bio-economy. Biotechnology in its broad sense includes traditional biotechnology, biotechnology in recent periods and modern biotechnology. Biotechnology in its narrow sense refers only to modern biotechnology. This paper focuses mainly on the development of modern biotechnology. The definition to biological technology proposed by US Biological Technology Industrial Organization (BIO), World Economic Cooperation and Development Organization (OECD) and several large authority organizations has the following two features: 1. The definition of biotechnology stresses modern biotechnology as well as expands its scope; 2. Besides the broad expression of the definition of biotechnology, the core position of modern biotechnology has also been stressed. This dilemma is the net result of the

current situation of biotechnology. On the one hand, the rapid development of biotechnology arouses uncertainty to the future development; on the other hand, biotechnology based on modern genes and cells demonstrated invaluable application prospects, and has become the focus of the current scientific research and industrialization [8].

Modern biotechnology includes genetic engineering (including protein engineering), cell engineering, enzyme engineering and fermentation engineering. Genetic engineering (also known as genetic engineering, recombinant DNA technology) is the core of modern biotechnology. The application of DNA operation new techniques, molecular biology and breeding technology involves a variety of different technologies. For example, flora and fauna gene manipulation and transgenosis, DNA isolation and cloning and other gene recombination and expression is to clip and assembly genes from different biological sources outside body, and connect with DNA vectors (plasmids, bacteriophages, viruses). Then it transforms to microorganisms or cells for cloning and makes transformed gene generate the needed protein in cells or microbes [9]. In 1997, a clone sheep “Dolly” came into being from the breast cell of a only 6 aged adult sheep in the United Kingdom. Since then, the clone technology has obtained unprecedented development, clone rat, clone cattle, clone pig, clone cat and clone monkey successively came out, but the largest application of clone technology is in medical area: Use cloning technology to cultivate human embryos and make it develop into various tissues and organs for medical or research purposes [10]. In the biotechnology field, in addition to the already mature gene technology, protein technology and bio-information technology, there are many new technology platforms such as stem cell applied technology, a new type of RNA technology, Nano-Biotechnology, systematic bio-technology and computer-support processing and so on. It also includes evolution technology, DNA replacement technology, metabolism technology, synthesis technology of natural substances, drug inference technology, RNA interference technology and liposome technology which are more in line with consumer demand [11]. It was predicted that 2010 will witness the maturity and promotion period of regenerative medical techniques, which will make a qualitative leap forward in medical technology. Biotechnological drugs which were produced from genetic engineering, antibody engineering and cell engineering technology, derived from living organisms, applied for internal diagnostic, treatment, or prevention have become the most important products of modern biotechnology production [12]. The breakthrough in gene sequencing technology has made it faster and cheaper. It subverted the traditional concept of health, that is, more precise diagnosis, and more personalized treatment. In September 2008, the United States Pacific Biosciences Company successfully developed the personal genome sequencing prototype, and announced the sales of personal genome sequencing instrument in 2013. It will complete personal genome sequencing within 15 minutes, and the cost for personal genome sequencing is less than $ 1000. In Britain and the United States and other developed countries, genetic testing services are as universal as a physical examination. In 2008, in terms of human adult stem cell transplantation to cure diseases, besides to cure leukemia with gradually matured marrow stem cells, using patient's own stem cells to cure heart disease, kidney disease, cirrhosis, and even partial limbs regeneration after amputation surgery have also experienced new development. Developing bio-probe instrument and various types of vaccines will be the hotspot of bio-industry development in the future [13].

In 1983, the first transgenic plants--transgenic tobacco came out. In 1986, 5 cases of genetically modified plants were allowed for test for the first time around the world. In 1994, the first transgenic plant –transgenic tomato was allowed to enter the US market. Since then, genetically modified plants, animals and microbes obtained through genetic engineering have obtained a series of breakthroughs. Genetically modified organisms have developed from the first generation of input features into medical, industrial and complex usage through the second generation of output characteristics, and the industrialization development trend is now irreversible. Transgenic technology has now been mature, particularly with regard to genetically modified plants [14]. Out of caution and concern for genetically modified products, we just consume genetically modified plants now, and transgenic animal products have not been really into people's lives. US scientists used genetically modified (GM) technology to improve the milk protein content produced by cows, which started the research to genetically modified food for higher organisms in the future. In terms of using GM technology to develop new varieties of plants, China has produced genetically modified starch; in terms of using transgenic technologies to foster new animal models, the United States has produced transgenic monkey models. In addition, the United Kingdom experts use genetically modified mosquitoes to cure malaria, Brazil uses genetically modified mosquitoes to combat infectious diseases, Germany developed transgenic pigs with diabetes models, and Argentina gained transgenic cows with bovine growth hormone [15]. Now the first generation of transgenic plants in agricultural production are mainly transgenic products for resisting diseases and insects [16], the developing first generation of genetically modified plants also include drought resistance and salt resistance transgenic crops [17]. The second generation of genetically modified products mainly focuses on improving quality and increasing nutrients, which can benefit more people. The third generation of GMOs will also include functional foods, bio-reactor, plant factories and high efficient bio-energy, which will enable agriculture to expand towards the pharmaceutical, chemical, environmental, and energy sector, and will play an important role in promoting agricultural sustainable development. Cell engineering and enzyme engineering technology research and develop the biotechnology products, and most industrial materials in the future will be colored by bio-technology products.

The international competition of biotechnology has been very fierce. Study the future demand for bio-industry in economic and social fields, deploy bio-technology in advance, as well as the original innovation and integrated innovation of next-generation technology. Such as the drone discovery technology in bio-medicine field, drug molecular design technology, genetic manipulation and protein engineering, stem cell-based human tissue engineering; intelligent sterility molecular design technology in biological agriculture field; new generation of industrial biotechnology, bio-refining technologies, synthesis biotechnology in bio-manufacturing field[18].

3 The Formation of Bio-industry

3.1 The Definition of the Term Bio-industry

Bio-industry mainly refers to the production and services of bio-technologies. Bio-industry is still in the early stages of development, so there is no uniform definition

to the scope of bio-industry. Some countries divided the industries according to the application of biotechnology in various areas. People have different understandings to the title and content of the term “bio-industry". For example, the United States, the United Kingdom, India and other countries called it "bio-technology industries"; while Japan and other countries called it "bio-industry". China has adopted "new biotechnology and pharmaceutical industry", "modern biotechnology", "biotechnology" and other titles, in 2007, the national "bio-industries ' Eleven-Five ' plans” determined the title of "bio-industry".

3.2 The Generation of Bio-industry

The beginning of modern biology industry was marked by the establishment of Genetech Company on April 7, 1976 by Herb Boyer and Bob Swanson in South San Francisco, its development has gone through four stages: The first stage, in the 1970s of the 20th century, the success of DNA recombination technology' marked the beginning and the birth of new era of biotechnology. The second phase, that is, the first wave, mainly reflected in the pharmaceutical biotechnological area. In 1982, the emergence of the first genetically engineered drug--recombinant human insulin--marked the rise of the bio-industry, and biotechnology has gone through a period of rapid development in the medical field. At present, the biopharmaceutical products account for more than 70%of bio-industry market share in a dominant position. The third stage, that is, the second wave, which occurred in the field of agricultural biotechnology and marked by genetically modified food. In 1996, genetically modified soybeans, corn and rape came into being, and biotechnology was rapidly used in agriculture. The fourth stage was in the late 1990s of the 20th century; the comprehensive application and confusion of biotechnology in industry, environmental protection, energy, marine, materials, information, and other areas formed a new wave of bio-industry.

4 Conclusion

The famous Futurist Paul in the United States has predicted: The representative science that promotes social development is changing from information sciences to life sciences. Information technology is accelerating the pace of human processing original information, while biotechnology can create more new wealth. In less than the time of a generation, every company will become biological material company--or become a ring in the development and application of biotechnology, or directly rely on it to get success. Information technology has lurked for nearly 100 years. The mutuality of bio-technological age will not take too long time, and only the time of a generation will be enough. Former technologies only change our lives without changing ourselves; biological science and technology will fundamentally change human, biological materials would start with changing the world economy, and eventually changing human view of the world. Bill Gates accumulated $ 1 billion within 12 years, while Jerry Yang and David Filler only used 3 years. However, when people are surprised by information technology, Bill Gates predicted that: The next richest person in the world will definitely come from the biotechnology sector.

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Ultrasonic Effect on Konjac Glucomannan Molecular Dimension

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Abstract. In this paper, the ultrasonic effect on konjac glucomannan(KGM) molecular dimension was discussed. The KGM polarity, molecular weight(Mw) and conformation were analyzed by digital polarimeter and LLS. The result indicated that the polarity change influenced by ultrasonic accorded with linear function equation. Mw of KGM gradually decreased with ultrasonic time. The concentration of KGM was lower, the effect was more obviously. The changes of KGM Mw also brought regular change of molecular conformation.

Keywords: Konjac Glucomannan, Ultrasonic; Polarity, Molecular Dimension.

1 Introduction

Molecular weight polysaccharides, especially some of the thousands or more has biologically active, has become a research focus in the natural polymer[1], its biological activity, chemical structure and structure-activity relationship had become the forefront of polysaccharide[2]. Konjac (Amorphallus Konjac K. Koch) is an araceae herbaceous perennial, the main component Konjac glucomannan (KGM) is a D-glucose and D-mannose ratio of 1:1.6 according to β-1,4 glycosidic linkage of complex polyols, the main-chain exist branched-chain structure, part of the sugar residues has the acetyl group[3]. KGM has a wide variety of sources, and excellent processing characteristics and biological activity, easy to use, and stronger reactivity [4]. is very interesting natural edible polysaccharide, many advantages has become a prospect environmentally friendly biological and medical materials[5].

KGM molecular size is related to application performance directly, study the variation of ultrasonic treatment has a certain significance.

2 Materials and Equipment

Konjac flour, Hubei Meili Group; reagents were of analytical grade.

Ultrasonic oscillator, PS3200, Provincetown Royal Co., Ltd.; Digital Automatic Polarimeter, WZZ-2SS, Shanghai Precision & Scientific Instrument; DAWN/ HELEOS laser light scattering instrument, the United States Huai Yate technology company.

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3 Experimental Methods

3.1 Purification and Determination of Molecular Weight on KGM

Reference to L.B[6] prepared KGM. With 0.2mol/L phosphate buffer prepared 1.0×10^{-3}g/mL KGM. Conditions of laser light scattering analysis: Shodex-G805 gel column, Opticlab rEX detector, wavelength 658nm, mobile phase 0.2mol/L phosphate buffer, flow rate 1.0mL/min, used Astra software.

3.2 Rotation Analysis

Prepared quantitative concentration of KGM hydrosol, effects of ultrasonic treatment time on the same concentration of water sol, and effects ultrasonic treatment same time on the value of rotation different concentrations of water-sol optical by the use of polarimeter analysis.

3.3 Molecular Characterization

The use of laser light scattering analysis of effecting ultrasonic treatment time and the same ultrasonic treatment time on the different concentrations of KGM molecular characteristics.

4 Results and Discussion

4.1 Rotation Analysis

Rotation is the physical properties of optically active substances, which determined by the molecular structure, and vulnerable to environmental factors.

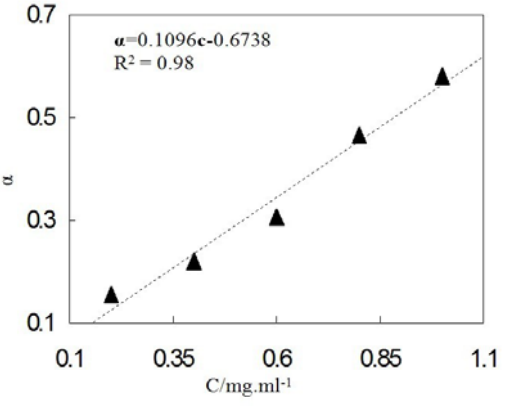

Fig. 1. Relativity of the KGM polarity and concentration

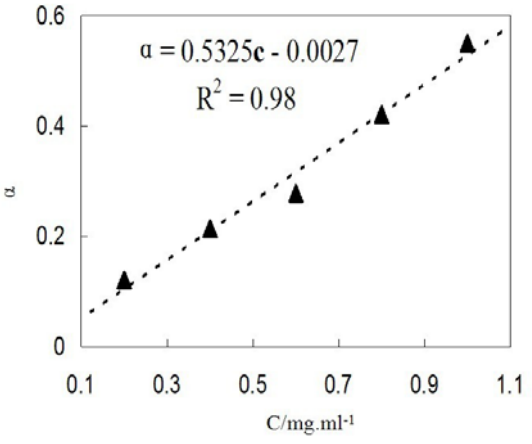

Fig. 2. The Polarity change of KGM influenced by ultrasonic 120min

Seen from Fig.1, KGM hydrosol has greater rotation value, the value is negative, indicating that KGM molecules may exist the left hand helix structure, and this spatial asymmetry increases linearly with concentration increases. Fig.2 shows after ultrasonic,KGM rotation increases with the concentration value increasing, but the rotation absolute value of the corresponding concentrations was decrease.

Further from Fig.3, with the increase of ultrasonic time, KGM optical rotation values reduced accordingly. This shows the existence of hydrogen bonding interaction from KGM molecular are destructed under the ultrasonic vibrations, and the longer, the greater the extent of the damage, resulting in the asymmetry of KGM molecules corresponding decrease, optical rotation values declining.

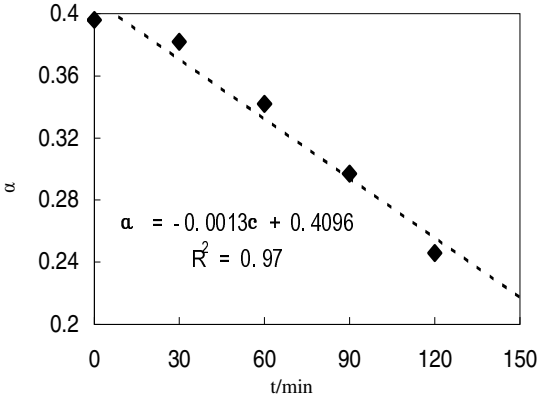

Fig. 3. Relativity of ultrasonic time and KGM polarity

4.2 Molecular Characterization Analysis

Experimental study of the main characteristics of a weight-average molecular weight (Mw) and Z-average molecular weight (Mz), expressed that molecular size; root mean square radius of gyration (Rn), expressed that share the size of the molecules in space.

4.2.1 Effect of Ultrasonic on Different Concentration of KGM Molecules

Fig.4 shows,with the concentration increase, Mw, Mz values of KGM are getting larger, especially Mw change significantly, the value fit the linear function equation. Further from Fig.5, under the influence of ultrasonic, size of low concentration in the water-sol on KGM than the high concentration smaller, with the concentration decreasing, the Rn value also will be reduced, and 0.1% changes more obvious. Corresponding of these data explained that at large concentrations of KGM, intermolecular hydrogen bonding interactions more stronger, to a certain extent,could resist the impact of ultrasound, and when low concentrations of KGM, hydrogen bonding interaction are weak and is bound by greater impact.

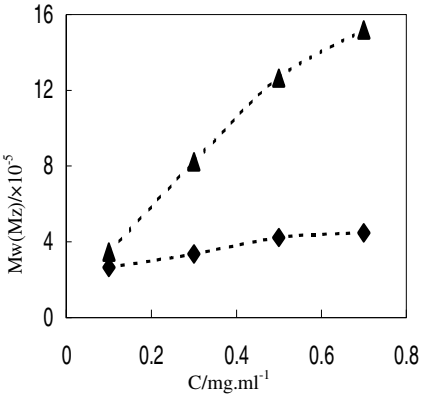

Fig. 4. The change in KGM's Mw and Mn

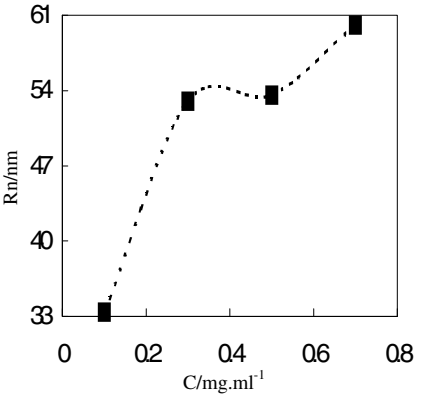

Fig. 5. The change in KGM's Rn

4.2.2 Effect of Ultrasonic Different Time KGM Molecules

Can be seen from Fig.6 and 7, with the prolonged of ultrasonic time, Mw value decreasing about changes linearly, Rn value decreases, indicating that ultrasonic time impact of KGM molecular size greater. Between 240min and 270min, Mw are no significant, possibly because of the ultrasound time continue to extend and its strength has not undermine the deeper KGM molecular structure. However, after 240min, the Rn value is still lower,it may be related to its molecular conformation, result in corresponding molecular size smaller.

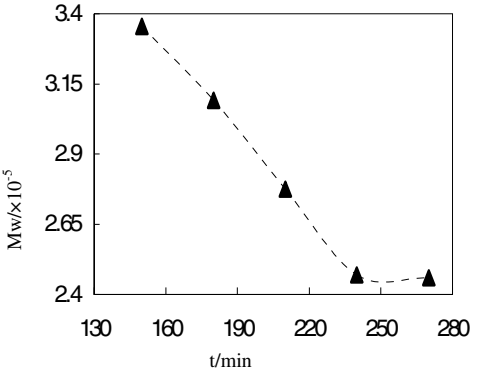

Fig. 6. The change in KGM's Mw

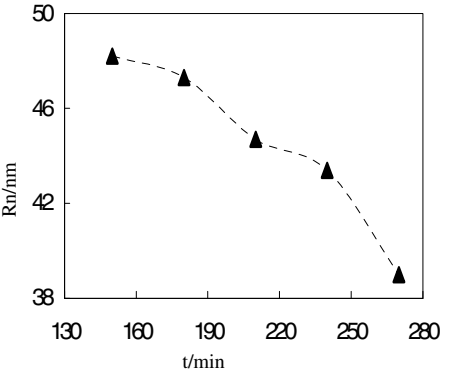

Fig. 7. The change in KGM's Rn

5 Conclusion

5.1 This space molecular asymmetry of KGM increases with increasing concentration, with the extension of ultrasonic time smaller, and the vaule changes trends are in line with the linear function equation.

5.2 Intermolecular hydrogen bonding interactions of large concentration on KGM are strong, to some extent can resistant to the impact of ultrasound. With the extension of ultrasonic time, the molecular characteristics of KGM changes larger.After 240min, the small changes in molecular weight, and root mean square radius changed greatly.

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Relativity on Granularity and Molecule Characteristics of KGM

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Abstract. In this paper, the relativity on the granularity with different mesh of konjac glucomannan(KGM) and molecular dimension was discussed. Laser particle size analyzer and laser light scattering were used to analyze the granularity distribution and molecular characteristics of KGM. The results showed that the granularity of KGM was gradually decreased after gradient refining. The Mw of KGM was gradually decreased with its granularity decrease and its molecular conformation was from globular to linear structure.

Keywords: Konjac Glucomannan, Granularity, Molecular Weight, Molecular Conformation.

1 Introduction

In new century, human resources facing health and environmental etc. these hot spots to stimulate the development of a natural polymer materials[1]. Because of its unique strong point, such as renewable, safety, environmental compatibility, and it could to promote their food, pharmaceutical industry, the traditional advantages of a new field[2] and chemical, textile, construction and environmental protection and other new development areas to play great potential applications[3]. Konjac (Amorphallus Konjac K. Koch) is an araceae herbaceous perennial, the main component Konjac glucomannan (KGM) is a very interesting natural polysaccharide, and it is a D-glucose and D-mannose ratio of 1:1.6 according to β-1,4 glycosidic linkage of complex polyols, with small side chains, the molecular weight of hundreds of thousands or even millions[4], has water-soluble, thickening, gelling and other features[5], a variety of sources, ease of using features make it become a promising environment-friendly bio-materials. Because of its application for the powder material is starting material, and the state and size of powder will inevitably affect the actual results of operations and applications[6], which is closely related to its molecular structure[7]. In view of this contact, this purified KGM for the study, its gradient refinement, discuss the size of the KGM and the correlation between molecular properties.

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2 Materials and Equipment

Konjac flour, Hubei Meili Group; reagents were of analytical grade.

DAWN/HELEOS laser light scattering, WREX-06, U.S. Huai Yate's; laser particle size distribution analyzer (Baxter Dandong Instrument: BT-9300).

3 Methods

3.1 Purification and Refined of KGM

Reference to L.B[8] prepared KGM. KGM was refineded respectively with a gradient of colloidal interval, after screening, obtained different screening KGM powder.

3.2 Determination of Molecular Weight

With 0.2mol/L phosphate buffer prepared 1.0×10^{-3}g/mL KGM. Conditions of laser light scattering analysis: Shodex-G805 gel column, Opticlab rEX detector, wavelength 658nm, mobile phase 0.2mol/L phosphate buffer, flow rate 1.0mL/min, used Astra software.

Used laser light scattering analysis 1.0 ‰ (w/v)KGM sample molecular weight, molecular conformation.for different sieve mesh (80-100; 220-280; 300-400; greater than 400).

4 Results and Discussion

4.1 Particle Size Distribution of KGM

Seen from Fig.1, particle size distribution of greater than 400 mesh from KGM mainly concentrated in the 10~100μm in ethanol from 0.1~100μm, the overall distribution patterns similar to normal distribution, the relative distribution is narrow.

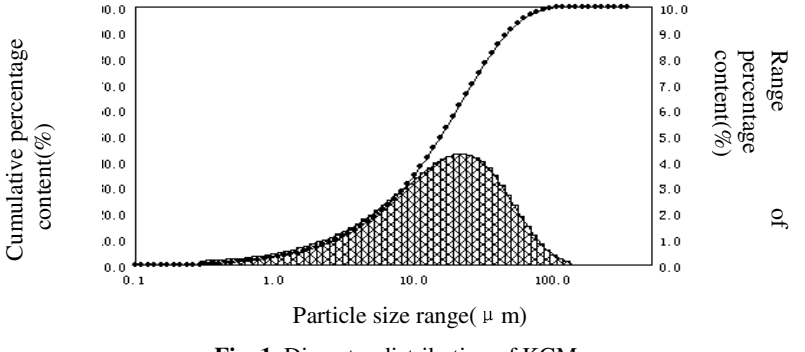

Fig. 1. Diameter distribution of KGM.

4.2 Different Mesh KGM and Size Correlation

Fig.2 shows after KGM by the gradient refined, in which median diameter (D50) gradually decreases, which is due to mechanical crushing and mutual collision of particles resulting pellets damaged, leading to macro-aggregation of KGM change shape, size reduced. But more than 300 mesh, the D50 of KGM decreased significantly, these indicating that the ordinary mechanical force was difficult to resulting in KGM deeper structure destroyed.

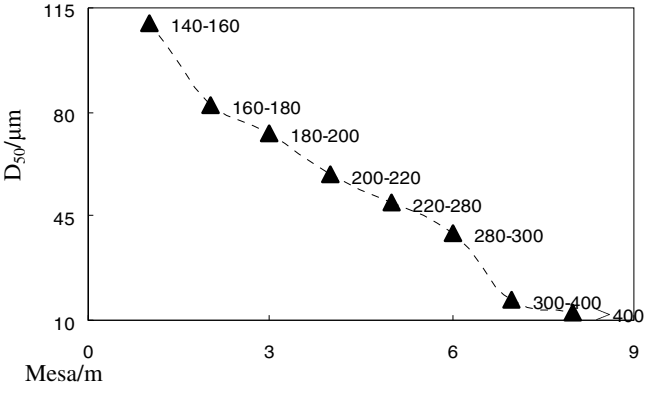

Fig. 2. The change in half-content diameter(D_{50}) of KGM powder

4.3 Molecular Characterization of KGM

Fig.3 shows the two detector analysis in curves of heterozygosity are good from the peak shape diagram of laser light scattering , showed a normal distribution, the peak width is narrow. Description purified polysaccharide KGM is relatively homogeneous, the relative concentration of molecular distribution.

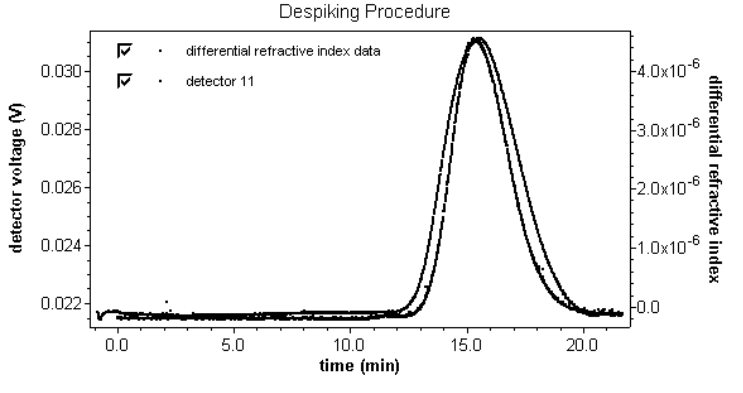

Fig. 3. GPC-LS-RI spectrum of KGM

4.3.1 Effects of KGM Different Mesh on Mw/Mn

In Fig. 4, KGM was by gradient refined, Mw/Mn value decreases, especially in the more significant changes in the first, then gradually leveled off, these indicating that by macro-mechanical force, KGM was cutted from uniform and orderly system, resulting in its molecular distribution become more concentrated.

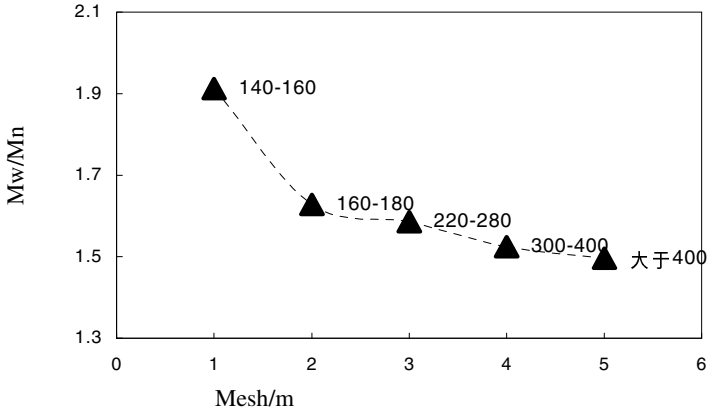

Fig. 4. The change in Mw/Mn of KGM

4.3.2 Effects of Different KGM Mesh on Mw

Mw decreased with decreasing particle size, indicating the destruction of macro-aggregation morphology also contributed to the size of molecular changing. At 300 mesh, Mw no longer decreases, indicating that it no further damage to ordinary mechanical molecular size, see Fig.5.

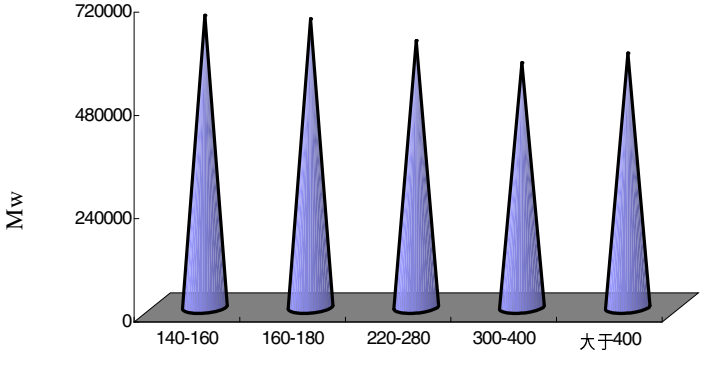

Fig. 5. The change in KGM's Mw

4.3.3 Effects of Different KGM Mesh on Rn

After KGM gradient refinement, it effect on Rn no obvious ro, see Figure 6. This shows that on the one hand Rn is related to the overall change of Mw, also there is a certain correlation with molecular conformation changing.

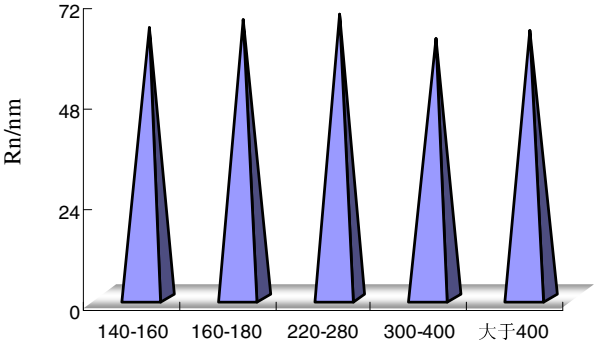

Fig. 6. The change in KGM's Rn value

4.3.4 Effects of Different KGM Mesh on β

β is the exponential equation Rn and Mw, as may be speculated that the molecular conformation. Fig.7 shows, KGM particle size decreases to change its molecular conformation larger, KGM molecules from the spherical conformation transition to linear molecular structure, this result corresponds exactly with the Rn did not change significantly.

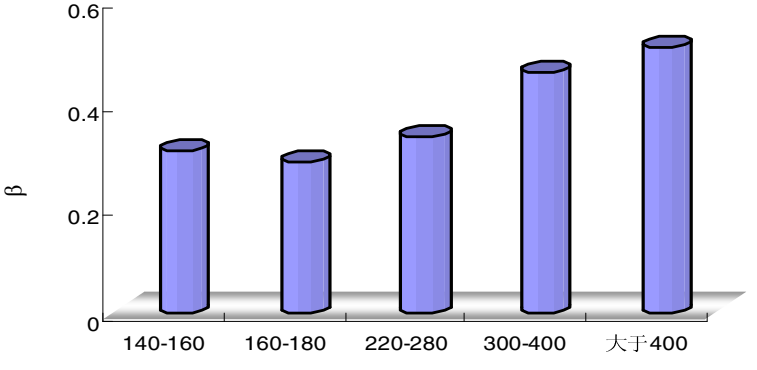

Fig. 7. The change in KGM's β value

5 Conclusion

After KGM refined by the gradient, particle size decreasing gradually; with the particle size decreases, Mw of KGM slow down, the Rn value was not significant, and its molecular conformation transited the spherical linear molecular structure.

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A Study of the Interaction between ELF-EMF and Bacteria

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Abstract. ELF-EMF, one of environmental factors, widely exists in natural world. However, the interaction between ELF-EMF and biological materials is usually neglected in the field of biological research. Very little efforts have been put forth in studying the relationship of bacteria and ELF-EMF. Here we investigated the stress reaction of *Escherichia coli*, *Salmonella*, *Bacillus subtilis* and OP50 cells to the stimulation of ELF-EMF. The results showed that the ELF-EMF treatment significantly decreased the colony forming efficiency of *Escherichia coli*, *Bacillus subtilis* and OP50 and this effect may be a kind of gene-dependence effect. In addition, this study also indicated that ELF-EMF could cause significant DNA damaged. *Salmonella*'s DNA was serious damaged in 50 Hz, 3 mT for 18 and 24 h. Moreover, short time continual stimulated, for instance, 10 and 14 h continual stimulated also caused DNA chain's broken to some extent. Continual stimulated and passage's result approved that this kind of DNA damaged could be decreased by serial passage and the damaged cause by ELF-EMF exposure might be a kind of gene toxic.

Keywords: ELF-EMF, Escherichia coli, Bacillus Substitute, Salmonella, gene -dependence, gene toxic.

1 Introduction

Extremely low-frequency electromagnetic field (ELF-EMF) is a kind of electromagnetic field which can be seen everywhere in daily life. In the natural world almost all living organisms are "immersed" in a variety of electromagnetic field, and interact with them. An increasing number of investigations have shown that ELF-EMF, produced by an alternating current (AC), might affect biological systems [1]. Several comprehensive reviews regarding in vivo and in vitro laboratory studies on ELF-EMF have been published to date [2-5]. To explain the potential mechanism, some hypothesis on DNA level was put forward [6-8]. However, the hypothesis which based on isolated cell culture is different from nature organisms. It is not fit for to understand the mechanism of biological effects induced by ELF-EMF. Furthermore, the isolated cell culture system has also neglected the reactions between multicellular organisms which play an important role in ELF-EMF's stress.

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Besides, many epidemiological studies pointed out that exposure to extremely low-frequency electromagnetic field (ELF-EMF) leaded to an increased risk for certain types of adult and childhood cancer which including leukemia, cancer of central nervous system and lymphoma [9-12], others [13-15] have failed to find such an association. Contradictory it may be. Very strong magnetic fields (5.2 – 6.1 T), for instance, are able to delay cell death in stationary cultures of *Bacillus subtilis* while a field of 14.1 T had no substantial effect on the growth of *Shewanella* oneidensis. AC fields (14.6 mT, 60 Hz) have been shown not to cause DNA breaks in a Salmonella test system. Various strains of *Escherichia coli*, including DNA-repair mutants, showed no evidence of increased DNA damage when exposed to very strong magnetic fields (0.5 and 3 T) [16-21]. Those reports suggest that the biological effects of ELF-EMF relative to the genotype of bacteria which was used in the experiment.

Whether or not an AC magnetic field exerts an inhibitory or else a stimulatory mode of action depends on a complex manner of the frequency, field strength, exposed time and genotype. For example, some observed elevated or even diminished growth rates for *Bacillus subtilis*, *Candida albicans*, *Halobacterium*, *Salmonella typhimurium*, and *Staphylococci* in dependence of AC frequencies ranging from 0-0.3 Hz and magnetic flux densities of 5-90 mT. In contrast, magnetic square wave signals (0.05-1 mT, 50 Hz) had no effect on the growth of E. coli [22-24]. The viability of *Escherichia coli*, *Leclercia adecarboxylata* and *Staphylococcus aureus* was negatively affected by prolonged exposures to AC fields of 10 mT, 50 Hz.

In considering the above problems, this paper was focus on certain magnetic field intensity (1~5 mT) and frequency (50 Hz). We attempted to use the single-cell organisms, *Escherichia coli*, to investigate the biological effects of organism after ELF-EMF's stimulate and its' potential mechanism. The research has positive significance in getting more information about ELF-EMF's biological effects and revealed its underlying mechanism..

2 Materials and Methods

2.1 Bacterial Strain and Culture Conditions

Escherichia coli, *Bacillus subtilis* were laboratory-preserved strains, *Salmonella typhimurium* TA1535/pSK1002, and OP50 were donation of Chinese Academy of Sciences, Institute of Plasma Physics. *E. coli* , *B.subtilis* and OP50 were first cultured in slant agar medium (beef extract 3 g/L, peptone 10 g/L, NaCl 5 g/L, pH 7.0) at 37℃ for 18 hours. Then cells were expanded in a 250 ml Erlenmyer flask containing 100 ml of liquid medium (beef extract 3 g/L, peptone 10 g/L, NaCl 5 g/L, pH 7.0) with agitation of 200 rpm on a rotary shaking incubator at 37℃ for 12 h. Salmonella were cultured in slant agar medium (beef extract 3 g/L, peptone 10 g/L, NaCl 5 g/L, pH 7.0 with Ampicillin 50mg/L) at 37℃ for 18 hours. Then cells were expanded in a 250 ml Erlenmyer flask containing 100 ml of liquid medium (beef extract 3 g/L, peptone 10 g/L, NaCl 5 g/L, pH 7.0, with Ampicillin 50mg/L) with agitation of 200 rpm on a rotary shaking incubator at 37℃ for 12 h.

2.2 Magnetic Field Generator

To investigate the bio-effects of biological material exposed to the ELF-EMF environment, the magnetic field generator was designed (see Fig. 1). This equipment was composed of two parts. One is the ELF-EMF generating unit. The other is current booster. The former contain a coil. In order to make sure the coils could generate a uniformity ELF-EMF, the electric current entered the booster first so that the current which will finally transport to the coils was stabilize. Temperature was controled in 37℃.

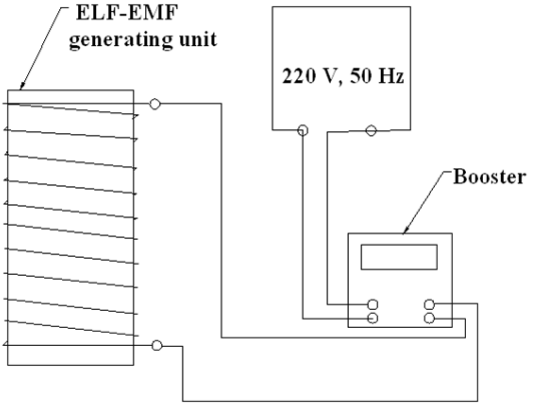

Fig. 1.

2.3 ELF-EMF Stimulation Experiments on E. coli, Bacillus subtilis and OP_{50}

Cells of E. coli, Bacillus subtilis and OP50 were cultured in liquid medium at 37℃ for 12 h were spread over to agar plates, and then they were exposure to 50 Hz ELF-EMF in the magnitude verify from 1 to 5 mT and The exposure time was set verify from 2 to 12 h. The total incubated time (including stimulation and interval time) was 24 h. The no stimuli groups were marked as CK while the stimuli groups were marked as T. The temperature within the coils was maintained at 37℃.

Samples were collected and colonies were scored after being exposure to ELF-EMF for 24 h. The relative colony forming efficiency (RCFE) was calculated according to the following formula:

Relative colony forming efficiency = (T/CK) ×100%

In this equation, CK represents the average colonies number from five plates in control group at 24th hour after being placed in the no-working coils. T represents the average colonies number from five exposure plates. Each experiment had fivefold plate and was independently repeated at least 3 times. The data were presented as means of relative colony forming unit ± SD.

In the continual stimulate and serial passage experiments, E. coli were selected for it's not only easy to cultivate but also get a distinct genetic background. And the

E. coli cells which incubated as mention above were stimulated in the way of continual stimulate and serial passage. In order to control the colony number and the precision of the experiment, the stimulated was carried on as follow (Fig. 2):

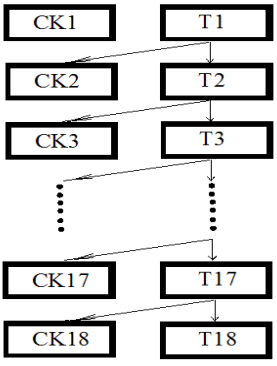

Fig. 2. ELF-EMF continual stimulate and serial passage experiments. In the serial passage, the first turn's CK groups and T groups were marked as CK1 and T1, in the second turn, CK groups and T groups were marked as CK2 and T2 independently, and this was went on till the CK18 and T18.

In the serial passage, the first turn's CK groups and T groups were marked as CK1 and T1, in the second turn, CK groups and T groups were marked as CK2 and T2 independently, and this was went on till the CK18 and T18. The data were presented as means of relative colony forming efficiency ± SD.

2.4 ELF-EMF Stimulation Experiments on Salmonella

Salmonella contained reported gene which would represent enzyme activity when its' DNA was broken. And the enzyme's activity was dependent on the DNA's broken level. After being cultured in liquid medium at 37℃ for 12 h, the cells of Salmonella were exposure to ELF-EMF. The stimulate groups were exposure to ELF-EMF and stimulated by 50 Hz, ELF-EMF magnitude 3 mT, the exposure time were varied form 2 h to 24 h. And the total incubated time (including stimulation and interval time) was 24 h. The no stimuli groups were marked as CK. The temperature within the coils was maintained at 37℃.

The relative activity of β-galactosidase (RAG) was defined as follow:

$$\mathrm{RAG}\left(\mathrm{units}\bullet\mathrm{ml}^{-1}\right)=\frac{1000\times\left(\mathrm{OD}_{420}-1.75\times\mathrm{OD}_{550}\right)}{\left(\mathrm{t}\times\mathrm{v}\times\mathrm{OD}_{600}\right)}$$

In the equation "t" was 25 min, "v" represented for the volume which is used in this research, 0.1 ml. Mena while, when T/CK >=2, it was considered that the T group's DNA were obvious damaged [25].

3 Results

3.1 The Effects of ELF-EMF Stimulation on *E. coli*'s Growth——Nonlinear Relation

ELF-EMF exposure (50 Hz, from 1 to 5 mT, 10 h continual stimulated) of the E.coli cells mentioned above revealed differences in RCFU. In 5 mT, E.coli showed the lowest RCFU (Fig. 3). And it can be seen that the RCFU was decreased accompanied with the magnitude increased. L. Fojt [26] has ever reported that the time dependence and/or magnetic field induction dependence can be approximated by an exponential function y=e-At, respectively y=e-KBm. What we found was in line with L. Fojt's research. And the polynomial regression for E.coli's growth in ELF-EMF was Y = A + B1*X + B2*X2 (Tab. 2).

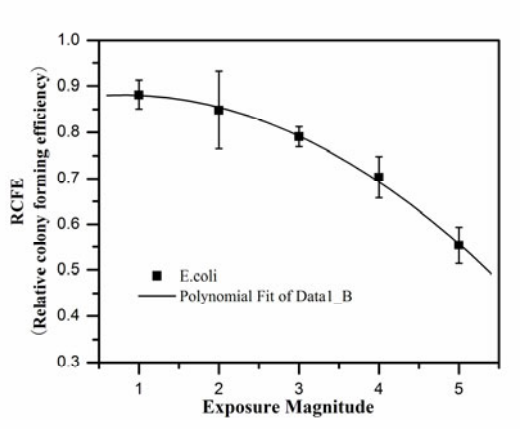

Fig. 3. E.Coli Dependence on Magnitude. —■— RCFE of E.coli, —— Exponential Fit of E.coli, and the exponential fit equation was Y= 0.90933+ 0.00344*X -0.0128*X2 (p=0.01256).

The data showed us that the E.coli reacted to different magnitude magnetic field in the same way; only the strength of the reaction is different. The quantity of the effect was revealed a magnitude-dependent——nonlinear relation. The main theories that tried to explain the biological effects of electromagnetic fields were based on the possible effects on the permeability of the ionic channels in the membrane [27]. And many kinds of ionic channels that may act under the stimulated of ELF-EMF can be seen in Tab. 3. In addition, ELF-EMF can change the transport of ions like Ca^{2+}, K^{+}, Na^{+} which were crucial to the survive of bacteria and this would lead to biological changes in the organisms. The other possible effects are the formation of free radicals due to magnetic field exposure.

3.2 The Effects of ELF-EMF Stimulation and Serial Passage Experiments on E. coli

Up to right now, researches on ELF-EMF's biological effects were always focus on one generation, there was nearly no paper put attention to bacteria exposure to

ELF-EMF stimulated and serial passage which was particularly essential in the study of ELF-EMF's biological effects and it's underlying mechanism for it will not only perform the accumulation effect but also perform us the trend which was relevant to mankind daily life in that the ELF-EMF was stimulated people in the way liked this experiment.

After been exposure to the ELF-EMF in 50 Hz, 3 mT for 10 h per passage, the RCFE of E.coli were marked in Fig. 4. Simple linear regression (Y=A+B*X) was done (the fit linear was drawn by Origin 7.5), and the simple linear regression equation was Y= 0.6434+ 0.00576*X (R= 0.46331, P= 0.0707, SD= 0.06033, N=16). The result indicated that accompanied with the passage, the RCFE was tend to rise (B=0.00576 > 0). Nordenson [24] considered that ELF-EMF would affect the chromosomal aberrations and hence inhibited or kill cells. However, S. Ivancsits' [6] research showed that ELF-EMF-induced DNA strand breaks could only be detected after intermittent, but not after continuous exposure. Our study was in line with Nordenson's research in that the ELF-EMF affects E.coli's DNA, and this affects will finally kill the E.coli cells. Moreover, we found that the RCFE tended to rise after stimulate and serial passage. May be, it was due to the induction of DNA-repair processes. And this was some liked S. Ivancsits' speculated [6]. Since S. Ivancsit did not perform the micronucleus assay at continuous exposure, it remains an open question whether or not continuous exposure was able to generate micronuclei and this might lead to difference between what S. Ivancsit found and what we found.

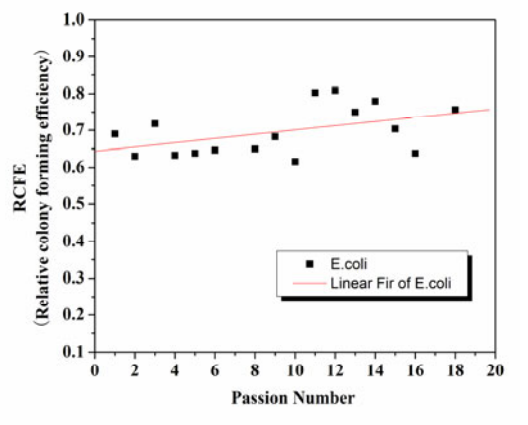

Fig. 4. Continual stimulate and passage on E.coli. RCFE of every passage were draw. And the Fit linear was made by Origin 7.5. The equation of the fit linear was: Y = 0.6434 + 0.00576 * X (p=0.0707).

3.3 The Effects of ELF-EMF Stimulation on Bacteria's Growth

Although many papers has put attention to the ELF-EMF's biological effects on people, epidemiology studies fail to point out the real effect that ELF-EMF caused in that the epidemiology studies always based on a limited areas and limited samples without any reasonable consideration on the difference of samples' gene type. Therefore, in vitro cells which got the same gene type were used in the recently

studies. When it came to bacteria researches, intercellular pathway, cell signalling and immune response were noticed. Bacteria, consequently, a kind of vital body which got the complete immune response and intercellular pathway were used in the ELF-EMF's biological effects studies. ELF-EMF, an important environmental factor, widely exists in the world. It inevitably affects the growth and metabolic behaviors of organism. Figure 5 shows effects of ELF-EMF stimulation on E.coli, Bacillus subtilis and OP50's growth. It can be seen that an obviously death were caused by ELF-EMF. Meanwhile, ELF-EMF's biological effects on different genotypes bacteria were no the same. After exposure to 50 Hz, 3 mT ELF-EMF, the RCFE of the three bacteria was gradually decreased with the exposure time. And it was interested to notice that this kind of biological effects were not performed as a linear relation especially when it came to OP50 which acted in an anomalous lightly decreased compared the ECFE in 24 h (76.397±5.536%) with 18 h (72.900±4.392%) exposure.

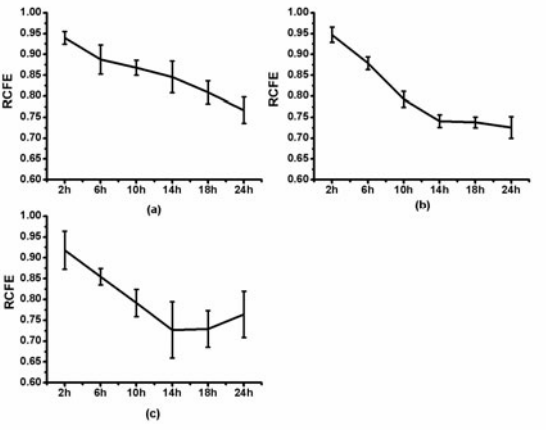

Fig. 5. Effects of ELF-EMF stimulation on E.coli, Bacillus subtilis and OP50. The stimulate groups were exposure to ELF-EMF and stimulated by 50 Hz, 3 mT ELF-EMF, the exposure time were varied form 2 h to 24 h. And the total incubated time was 24 h. The data were presented as means of relative colony forming efficiency ± SD. (a) Bacillus subtilis, (b) E.coli, (c) OP50.

The result indicated that the ELF-EMF resonances differ from strain to strain and depend on genotype. This was in line with I. Y. Belyaev's research [28]. In particular, these cells have a mutation in the lac operon, which is responsible for the catabolism of the disaccharide lactose in E.coli, as well as mutations affecting the metabolism of arabinose, arginine, threonine, leucine, proline, galactose and some other compounds [29]. With respect to the negative interaction between ELF-EMF and bacteria cells, ion cyclotron resonance of bacterial cell induced by ELF-EMF forces may be the first factor to consider (see Tab. 3). What's more, most of the ion channels of the outer membrane were not statically opened, as commonly held, but were closed at rest and may be openable by physiological stimulated like ELF-EMF [30]. More and more investigations showed that ELF-EMF play an important role in cellular metabolism, gene expression, cell growth and proliferation [31-33]. Consequently, concerning to

cells, responding to ELF-EMF may be the main reason to create biological effects, though it was not very cleared that how the ELF-EMF stimulated signal was taken over and then transferred to intracellular by the cells to bring about a further series of biological effects.

3.4 The Effects of ELF-EMF Stimulation on Salmonella 's DNA

The environmental stress response is an important physiological mechanism that protects cells and organisms from stressful changes in their environment. To ensure survival in the face of these afflictions, such as change in temperature, pH, osmolarity, radiation and the concentration of nutrients and toxins, organisms cannot but adapt to changes in their immediate vicinity by responding to the imposed stress. In order to have a thorough knowledge of ELF-EMF's biological effects, this part was focused on the on the change of DNA that taken place while faced to ELF-EMF stimulated.

Table 1. THE EFFECT OF ELF-EMF EXPOSURE TIME ON *Salmonella typhimurium* TA1535 DNA DAMAGE. Salmonella were exposure to 50 Hz, 3 mT of ELF-EMF, cultivated in 37℃, pH 7.0, continual stimulated time varied from 2 h、6 h、10 h、14 h、18 h to 24 h. T was stimulated group, CK was control group.:

Exposure time	RAG		T/CK
2h	T	0.148920328	0.488
	CK	0.304878049	
6h	T	2.4506218	1.628
	CK	1.504513541	
10h	T	1.600609756	1.968
	CK	0.81300813	
14h	T	1.396160558	3.448
	CK	0.4048583	
18h	T	1.832460733	6.0532
	CK	0.302724521	
24h	T	5.593385214	11.064
	CK	0.505561173	

The influence of ELF-EMF's stimulation on Salmonella's DNA was shown in Tab. 4. The result indicates that ELF-EMF significantly broken the Salmonella's DNA in 50 Hz, 3 mT for 18 and 24 h, resulting in the high enzyme activity. Furthermore, short time stimulated, for instance, 10 and 14 continual stimulated also caused some extent DNA chain's broken. We believe that, first of all, ELF-EMF, a kind of physical factors, have been suggested that, interaction with electrons in DNA is likely for some reasons. The biochemical compounds in living cells are composed of charges and dipoles that can interact with electric and magnetic fields by various mechanisms. For instance, displacement of electrons in DNA would cause local charging that has been shown to lead to disaggregation of biopolymers [34]. Secondly, very weak ELF fields

have been shown to affect the rates of electron transfer reactions [35,36]. As the energy in an EMF stimulus increases, there is an increase in single strand breaks, followed by double strand breaks, suggesting an interaction with EMF at all energy levels [37]. The low EMF energy can move electrons, cause small changes in charge distribution and release the large hydration energy tied up in protein and DNA structures [38]. Electrons have been shown to move in DNA at great speed [39], and we have suggested that ELF fields initiate the stress response by directly interacting and accelerating electrons moving within DNA [40,41]. In addition, the ELF-EMF treatment was likely to evoke a stimulation of the growth of bacteria by means of other unknown mechanisms, such as signaling pathways, in which EMF stimulate serum response factor which binds to the serum response element (SRE) through ERK MAPK activation and is associated with injury and repair in vivo [42], and so on.

4 Disscussion

ELF-EMF, one of environmental factors, widely exists in the world. It undoubtedly interacts with all living beings and affects the growth and metabolic behaviors of organism. Few efforts has been put forth in studying the relation of organisms which got the intercellular pathway, cell signalling and whole immune response and ELF-EMF, although many phenomena supporting the claim that living organisms acknowledge and respond to ELF-EMF have been observed. In order to better understand the biological effects of ELF-EMF, here we investigated the response behavior of bacterial cells to ELF-EMF's stimulated.

The results showed that E.coli reacted to different magnitude ELF-EMF in the same way; only the strength of the reaction is different. This effect might be some like time-dependent and performed in an nonlinear relation but exponential relation. Meanwhile, the ELF-EMF's biological effects were different from strain to strain and depend on genotype. ELF-EMF treatment significantly inhibited the growth of Escherichia coli, Bacillus subtilis and OP50. In addition, ELF-EMF's biological effects on different genotypes bacteria were no the same. Exposure to 50 Hz, 3 mT ELF-EMF, for 14 to 24 h will caused OP50 performed a "magnitude window" effect while in the same stimulate condition, E.coli and Bacillus subtilis would not appear "magnitude window" effect. What's more, the ELF-EMF's biological effects on the three bacteria were not acted in the manner of linear relation. Particularly, these cells have a mutation in the lac operon, which is responsible for the catabolism of the disaccharide lactose as well as mutations affecting the metabolism of arabinose. Further more, most of the ion channels of the outer membrane were not statically opened, as commonly held, but were closed at rest and may be openable by physiological stimulated like ELF-EMF.

This study also showed that ELF-EMF could cause DNA changed. Salmonella's DNA was significantly damaged in 50 Hz, 3 mT for 18 and 24 h and short time continual stimulated, for instance, 10 and 14 continual stimulated also caused some extent DNA chain's broken. Continual stimulated and passage's result showed that this kind of DNA damaged could be decreased by continual passage and the damaged cause by ELF-EMF exposure may be a kind of gene toxic. Firstly, the ELF-EMF

energy can move electrons and cause small changes in charge distribution and release the large hydration energy tied up in protein and DNA structures. Displacement of electrons in DNA would cause local charging that has been shown to lead to disaggregation of biopolymers. Secondly, very weak ELF fields have been shown to affect the rates of electron transfer reactions. As the energy in an EMF stimulus increases, there is an increase in single strand breaks, followed by double strand breaks, suggesting an interaction with EMF at all energy levels. The ELF-EMF treatment was likely to evoke a stimulation of the growth of bacteria by means of other unknown mechanisms, such as signaling pathways, in which EMF stimulate serum response factor which binds to the serum response element (SRE) through ERK MAPK activation and is associated with injury and repair in vivo, and so on.

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Effects of Tertiary Air Staged Combustion on NOx Emission Characteristic in a Pulverized-Coal Boiler with Swirl Burner

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Abstract. Air-staged combustion which moves parts of the jet of tertiary air to the top of Primary combustion zone for reducing the generation of NOx in a 300 MW pulverized-coal boiler with Swirl Burner. The primary purpose of this work is to investigate the effect of moving parts of the jet of tertiary air and changing the ratio of tertiary air on the distribution of temperature, the efficiency of combustion and the emission of NOx. When the ratio of upper tertiary air is increasing, the concentration of NOx is decreasing, but the carbon content in fly ash is increasing and it will affect the efficiency of combustion. Comprehensive comparison of all projects, when the ratio of upper tertiary air is 70%, the carbon content in fly ash is 3.31% and the emission concentration of NOx in the export of air preheater can decrease to 767mg/Nm^3.

Keywords: air-staged combustion, tertiary air, pulverized-coal boiler.

1 Introduction

Coal-fired power plant is the major emission sources of atmospheric pollutant for example the dust, SO_2 and NOx in China. Dust and SO_2 are controlled basically along with the governance of atmospheric pollutants, but the governance of the NOx is still in the initial stage. It will not be changed that coal is a main energy source at the present stage. The consumption of coal will increase continuously, it is estimated that by the year 2010 coal production will reach above 2.9 billion tons or more. With the development of economy and the increasing demand for electricity, the thermal power generation capacity reached 601 gig watts and will reach 1200 gig watts in 2020. According to the current level of emissions, the emission of NOx will reach 10.38 million tons in 2010 and will reach 14.52 million tons in 2020[1].

With the growing emissions of NOx, China will make greater efforts to control NOx emissions. It is hoped that more practical and more economical technique which can reduce the emission of NOx will be selected [2]. Because of the high cost and the operation cost, fuel gas deNOx control technologies are not practical adopted widely. Low NOx combustion technologies are more practical for its low cost, low operation

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cost and better effect of low NOx. Low NOx combustion technologies conclude low NOx burner, air staged combustion technology and fuel staged combustion technology. These technologies mainly adopt combustion adjustment to low NOx in the process of combustion. Using air staged combustion technology to low the NOx emission of 300 MW pulverized-coal boiler with Swirl Burner, it is hoped that smaller transformation can get a better effect of lowing NOx emission. It renders an important reference to popularize this technique to the same kind of boiler.

2 NOx Formation Mechanisms

2.1 NOx Formation Mechanisms

NOx can be formed in the processes of combustion, which are classified as: thermal NOx, prompt NOx and fuel NOx. Thermal NOx is formed from oxidation of atmospheric nitrogen at relatively high temperature in fuel-lean environments [3]. Prompt NOx is formed by the reaction of atmospheric nitrogen with hydrocarbon radicals in fuel-rich regions of flames, which is subsequently oxidized to form NOx [4]. Fuel NOx is formed when nitrogen bound in the coal, both in the volatile matter and in the char, combines with excess oxygen of the combustion air [5].

The formation of thermal NOx is modeled by the extended Zeldovich mechanism as follows. It has strong temperature dependence and the temperature is in direct proportion to the formation of thermal NOx. When the temperature of some regions is above 1800K, the formation of NOx will increase by exponential. In the practical combustion process, it will appear some regions with high temperature; it will make the formation of NOx increase, so avoiding the high temperature region which above 1800K can inhibit the formation of NOx abundantly.

$$N_2 + O \rightarrow N + NO \tag{1}$$

$$N + O_2 \rightarrow O + NO \tag{2}$$

$$N + OH \rightarrow O + NO \tag{3}$$

The formation of prompt NOx is in the condition that the excessive air coefficient is less than 1. In the process of combustion, the hydrocarbons radicals collide with N_2 generate the compounds of CH and then it is oxidized to NOx. Prompt NOx is only significant in fuel-rich systems, and is a small portion of the whole NOx formation in the process of combustion.

Fuel NOx is formed by the oxidation of nitrogen bound in the coal in oxygen-rich regions. The nitrogen of coal is partially released in the volatiles and partially retained in the char. In the volatile matter the nitrogen containing intermediate species is widely accepted as HCN and NH_3. In fuel-lean regions HCN and NH_3 react to O_2 form NOx and in fuel-rich regions HCN and NH_3 react to O_2 form N_2. In addition, in the process of char combustion the nitrogen containing in the char is oxidized to NOx, in the meantime, part of NOx will react to C which is on the surface of char form N_2. The main objective of lowing fuel NOx is to reduce the contact between nitrogen from the fuel and oxygen in the combustion air [6], the main reaction mechanism as follow.

$$HCN/NH_3+O_2 \rightarrow NO+\cdots \quad (4)$$

$$HCN/NH_3+NO \rightarrow N_2+\cdots \quad (5)$$

$$N_{Char}+O_2 \rightarrow NO \quad (6)$$

$$Char+NO \rightarrow N_2+\cdots \quad (7)$$

2.2 Air Staged Combustion Technology

In the three types of NOx, thermal NOx is 15%~20% percent of the total NOx emissions; prompt NOx is 5% percent; fuel NOx is 75%~80% percent, so in the practical process of combustion, thermal NOx and fuel NOx are considered mainly.

Base on NOx formation mechanisms, the main objective of reducing the formation of NOx is to minimize the temperature of reaction regions and the contact between nitrogen in the fuel and oxygen from the combustion air. Air staged combustion technology is the concrete applications base on this theory. Air staged combustion technology divide the process of combustion into two stages.

First stage is to reduce the air quantity and put the residual air on the primary combustion zone as replenish-ment. When the excessive air coefficient is less than 1, the coal will be imperfect combustion in fuel-rich regions, it will reduce the velocity of combustion and the tempera-ture in primary combustion zone, the formation of thermal NOx will decrease. In addition, imperfect combustion will produce reducing ambient to decrease the rate of formation of fuel NOx.

Second stage is to put the additional air into the region which is above primary combustion zone for complete combustion. Combining the coal of incomplete combus-tion with the additional air the remaining coal will burn out completely in the condition of the excessive air coefficient is greater than 1. Because of low temperature and higher air volume, it reduces the temperature of the primary combustion zone and contains the formation of NOx.

Adopting air staged combustion technology, the smaller the excessive air coefficient is, the better the effect of inhibiting NOx formation, but it will make more product of incomplete combustion, reduce the efficiency of combustion and slagging in the furnaces. It should organize the air staged combustion correctly for reducing the emission of NOx and making sure of the economy and reliability of combustion.

3 Study Object and Reconstruction

3.1 Study Object

The pulverized-coal boiler with Swirl Burner in this study is a 300 MW, natural circulation, single furnace balanced ventilation and dry-bottom unit. The cross sectional dimensions of boiler are 13350mm×12300mm, as shown in Fig.1. The type of burners is EI-DRB. Twenty-four burners with different swirl direction are arranged on the front and the back of the wall, and are opposite each other in four levels. There are four steel ball coal mills in coal pulverizing system, pulverized-coal system with inter -mediate storage bunker. Sixteen jets of tertiary air are arranged on the wall and

are opposite each other in two levels and arranged symmetrically between the adjacent burners. There are eight jets of NOx located on the wall and above the primary combustion zone as shown in Fig.2(a).

Fig. 1. The structure of furnace

3.2 Reconstruction

By moving parts of jets of tertiary air to the top of the primary combustion zone, it will make oxygen-lean in the primary combustion zone, parts of pulverized coal is incomplete combustion, it will enhance reducing atmos-phere and inhibit the formation of NOx. In addition, it is good for the pulverized coal fired by removing parts of jets of tertiary air which next to the burner, because the temperature of tertiary air is low. The remaining air is put into the top of primary combustion zone; it can ensure the remaining coal burnout. The temperature of remaining air is low; the remaining coal burnout in the region of low temperature the NOx emission can not produce more and the total NOx emission will reduce.

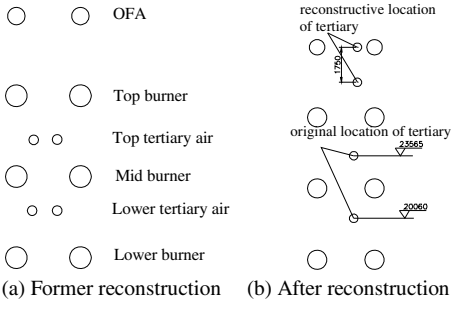

Fig. 2. Former and after reconstruction of half Primary combustion zone

Though low NOx combustion burners were installed in the furnace and adopting low NOx combustion technologies, the emission of NOx still increase for the bad properties of the coal. When the boiler was designed, air staged combustion had been

taken into account and the positions of over fire air can make sure that the unburned pulverized-coal continue to burnout. If the parts of jets of tertiary air move to the top of the over fire air, it will extend the time of the pulverized-coal burnout, carbon content in fly ash will increase and the efficiency of combustion will decrease. If the parts of jets of tertiary air move to the position between the top of primary combustion zone and the section of over fire air, it will get the same result as above. In order to reduce the adverse effects made by tertiary air, the parts of jets of tertiary air will be located between the top of primary combustion zone and the section of over fire air in two levels, after reconstruction of half Primary combustion zone is shown in Figure.2(b).

4 Measurements

Using flue gas analyzer to measure the concentration of NOx in the air preheater and adopting grid method to arrange sixteen sampling points, data gathered on-line, four sampling points were arranged in the inlet of the air preheater, twelve sampling points were arranged in the outlet.

In the inlet and outlet of the air preheater, twelve sampling points were arranged separately for measure temperature.

In the peephole of the furnace, the temperature of furnace was measured by pyrophotometer.

5 Results and Discussion

5.1 Influence of Coal Mill

The boiler which uses pulverized-coal system with intermediate storage bunker put exhaust air with parts of fine breeze as tertiary air into the boiler for improving the efficiency of economical. The characteristic of tertiary air is low temperature, fine coal and high speed of wind. It will cause some adverse effects, for example decreasing the temperature of flame, combustion instability, et al, but there are some advantages can be used, for example smaller particles of pulverized-coal, easy-to-fire and rapid combustion, et al. In the characteristics of ignition, Primary air is better than tertiary air. It will play a key role to inhibit the formation of NOx for tertiary air.

Studying on the influence of combustion and NOx formation at the operation with mill and non-mill was performed with the rated load in the furnace. Tertiary air take part in the combustion with mill. By adjustment air staged combustion can be still used to reduce the formation of NOx with non-mill.

Fig.3 shows the temperature distribution along the height of furnace with mill and non-mill. It is not much difference at the temperature distribution; the highest temperature is nearby the section of OFA. The temperature is higher with the operation of mill than with the operation of non-mill in the section between mid burner and OFA. It is the reason that the temperature of tertiary air is low (about 90℃), when the tertiary air is mixed with fuel gas, it will reduce the tempera -true of the furnace. In addition, the jets of tertiary air are arranged nearby mid burner, it will

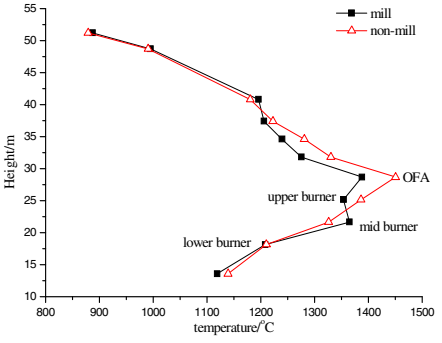

Fig. 3. Temperature distribution along the height of furnace

reduce the temperature of the section from the top of mid burner to the exit of furnace and the difference of temperature in the section of OFA is 62.25℃ between mill and non-mill.

Fig.4 shows the influence to carbon content in fly ash and slag with and without mill. Carbon content in fly ash and slag is higher and the efficiency of combustion is lower with mill than without mill. The main reason is that when low temperature of tertiary air mix with flue gas in primary combustion zone, it will reduce the temperature of primary combustion zone and the speed of combustion, the characteristics of pulverized coal combustion is worse. In this case Slag and carbon content in fly ash will increase. Because the nitrogen from volatile oxidize to NOx is the integral part of fuel NOx and the fuel NOx is 75%~80% percent in total of NOx, the content of nitrogen in volatile will decide the total of the formation of NOx. Tertiary air is put into the furnace with mill, there is not tertiary air put into the furnace without mill. Though the presence of tertiary air will reduce the temperature of the primary combustion zone, it won't influence the volatile separate out from pulverized -coal and the particle size in the fine powder is small than pulverized-coal, the fine powder will release volatile faster than pulverized-coal, the formation of NOx will be more with mill than without mill. Carbon content in fly ash and slag are reduced obviously, carbon content in slag is decreased by 46.4% and carbon content in fly ash is decreased by 17.2%. It indicates that the situation of combustion is better without mill than with mill and the thermal efficiency of furnace is above guarantee value which is 91.75%, Tertiary air impact the combustion of lower burner greater. The concentration of NOx is decreased from 1074mg/Nm^3 with mill to 1047mg /Nm^3 without mill.

It can conclude that the efficiency of combustion and the reduction of NOx formation without mill are better than with mill, but the concentration of NOx can't decrease the guarantee value which is 800mg/Nm^3. It can reduce the formation of NOx with increasing the volume of over fire air, but it could enhance the reducing atmosphere in primary combustion zone, the region nearby the water wall can be prone to high temperature corrosion, Carbon content in fly ash and slag increase, the efficiency of combustion will be worse than before. It must improve air-staged combustion technology and select a new way which is operated and adjusted easily, little influence to the furnace. But there are some advantages of tertiary air can be

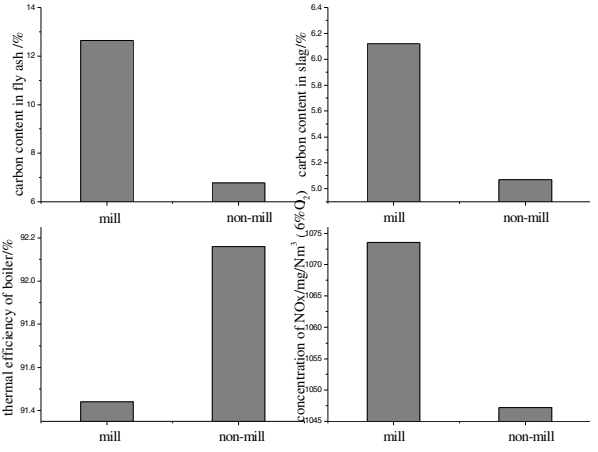

Fig. 4. Comparisons of results with and without mill

used, for example smaller particles of pulverized-coal, easy-to-fire and rapid combustion, et al. In addition, it is easy to reconstruct the position of tertiary air and adjust the volume of tertiary air to realize air staged combustion.

Moving parts of jets of tertiary air can enhance the reducing atmosphere in primary combustion zone to inhibit the formation of NOx; furthermore, moving parts of tertiary air which is low temperature is good for the combustion of pulverized coal. The position which parts of the tertiary air move to is between the section of OFA and above the primary combustion zone. It can put the remnant air into the furnace in two levels and make sure the residual pulverized-coal burnout.

5.2 Influence of Tertiary Air

Fig.5 shows the temperature distribution at different proportion of upper tertiary air. With the proportion of upper tertiary air increase, the distribution of temperature volume of furnace is lower than before. Increasing the volume of upper tertiary air

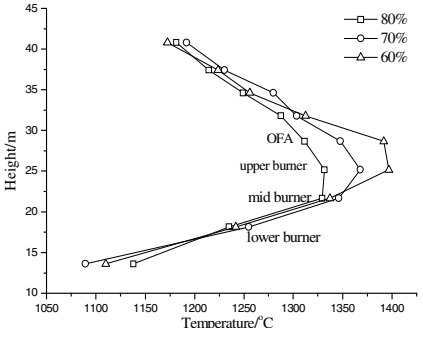

Fig. 5. Temperature distribution at different Proportion of upper tertiary air

and decreasing the volume of oxygen can make the pulverized coal burn at oxygen-lean, the rate of combustion is lower and the temperature is reduced. In the section of the tertiary air present, the temperature is highest as the proportion of upper tertiary air is 60% and the temperature is lowest as the proportion of upper tertiary air is 80%. The difference is 65℃ between the lowest temperature and the highest tempera-ture. The distribution of temperature in the furnace is decreased as the volume of upper tertiary air increase.

Fig.6 shows the variety of carbon content in fly ash and slag, the thermal efficiency of boiler and the concentration of NOx with different proportion of upper tertiary air. With increasing the proportion of upper tertiary air, the concentration of oxygen is decreased; it will generate a lot of CO which can form reducing ambient and inhibit the formation of NOx, so the concentration of NOx is decreased with increasing the proportion of upper tertiary air. In addition, decreasing the concentration of oxygen can increase the carbon content in fly ash and reduce the efficiency of combustion, but it can't influence the carbon content in slag indicate that there is no effect on the carbon content in slag as increasing the proportion of upper tertiary air. When the proportion of upper tertiary air is 70%, the carbon content in fly ash is 3.31%, the concentration of NOx at the exit of air preheater is 767mg/Nm^3 which is blow the guarantee value (800mg/Nm^3) and the thermal efficiency of boiler is 92.36% which is above the guarantee value (91.75%). The proportion of upper tertiary air is 70% which is the best operating mode.

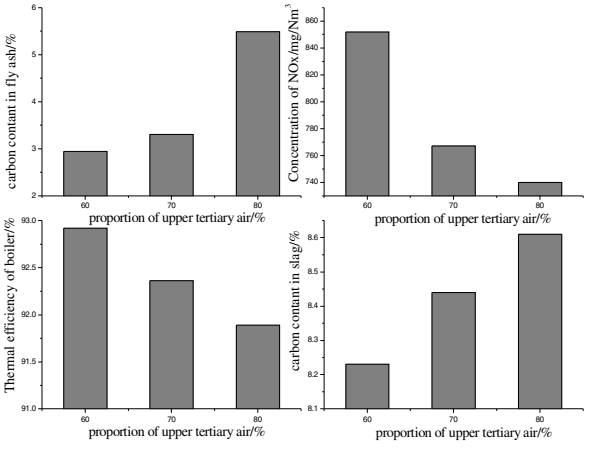
carbon contant in fly ash/%
Concentration of NOx/mg/Nm3
Thermal efficiency of boiler/%
carbon contant in slag/%
proportion of upper tertiary air/%
proportion of upper tertiary air/%
proportion of upper tertiary air/%
proportion of upper tertiary air/%

Fig. 6. Comparisons of results with different proportion of upper tertiary air

6 Conclusions

The concentration of NOx is decreased from 1074 mg/Nm^3 with mill to 1047mg/Nm^3 without mill, but the concentration of NOx can't decrease the guarantee value which is 800mg/Nm^3.The position which parts of the tertiary air move to is between the section of OFA and above the primary combustion zone, by adjusting the volume of upper tertiary air can reduce the formation of NOx. When the

proportion of upper tertiary air is 70%, the carbon content in fly ash is 3.31%, the concentration of NOx at the exit of air preheater is 767mg/Nm^3 and the thermal efficiency of boiler is 92.36%. The proportion of upper tertiary air is 70% which is the best operating mode.

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Scheme Optimization for Seismograph Recognition and Multifold Seismic Data Rolling Acquisition Experiment*

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Abstract. Classroom teaching is the theory teaching, and is the basic mode and method of knowledge teaching. Experiment is the previous examination for the application of knowledge entrusts. Only organic combination teaching with both classroom teaching and practice teaching, can make students to understand knowledge spots and master knowledge profoundly, thus achieve the goal of flexible application. This paper carries on the teaching scheme of "Seismograph recognition and multifold seismic data rolling acquisition experimen" optimization, and uses in one participating teaching, has made a good teaching progress.

Keywords: Seismic exploration, Seismograph recognition, Seismic data acquisition, Classroom teaching, Practice teaching.

1 Introduction

Classroom teaching is the theory teaching, is the basic mode and the method of knowledge teaching, so the classroom teaching is very important. And experiment is the previous examination for the application of the knowledge entrusts, is the stage for the student exercises the beginning ability, and it is also important. Only organic combination teaching with the both classroom teaching and practice teaching, can make the student to understand knowledge spot and master knowledge profoundly, thus achieve the goal of flexible application. "Seismograph recognition and multifold seismic data rolling acquisition experiment" is one method experiment of "Seismic Exploration Principle and Method" for the undergraduate majors of Investigation Technology and Engineering. At present, because student is many (several classes), seismograph is limited (one suit), and class hour is few (2 class hours). In order to improve the teaching quality of curriculum and mastery effect for students, in the foundation of tradition

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educational model, we must optimize the experiment teaching scheme, improve teaching method, and enhance the teaching effect.

2 Experiment Goal and Content

2.1 Experiment Goal

Through the experiment of "Seismograph recognition and multifold seismic data rolling acquisition experiment", take students recognize the seismic apparatus (including seismograph, geophone, electric cable line, seismic source and so on), grasp the construction steps of acquisition, the principle of work and method for reflection method, as well as design the multifold observation system optimization and gathering parameter optimization choice. The goal is as follows:

- Recognize Seismic apparatus and equipment (including seismograph, geophone, electric cable line, seismic source).
- Deepen understanding the method principle of multifold seismic data trundle acquisiting and application.
- Through design a set of reflection seismic observation system, and realize reflection seismic data acquisition in field.
- Understand the step of seismic data acquisition and the method in field.
- Recognize seismic wave field, and master the ability of analysing seismic record characteristic.

2.2 Experiment Content

- Recognize the equipment of seismic acquisition system: Can point out the equipments and so on seismic survey recording instrument, electric cable line, geophone functions, familiar each kind of equipment's performance and characteristic.
- *Design seismic observation system*: According to seismic survey goal, field condition design seismic observation system.
- *Multifold seismic data trundle gathering method*: Does practice seismic survey trundle gathering, including the center of origin, the electric cable, how the detector place with rolls forward the construction.
- *Geophone combination experiment*: Change geophone combination way, observation seismic record change.
- *Recognize seismic wave field characteristic*: According to seismic record which was gathered, basis seismic wave field characteristic identification and recognition different seismic wave field, including effective reflected wave and disturbing wave (for example refracted wave, surface wave, random disturbance, 50Hz electric cable wave and so on).

3 Experiment Plan Optimization

The content of "Seismograph recognition and multifold seismic data rolling acquisition experiment" is full, duty is heavy, student is many (present 4 classes),

class hour is few (2 class hours), and instrument is limited (one suit). For guarantee curriculum quality of teaching, Enable the student in limited resources and time to grasp the rich content experiment, even learns more knowledge, we must optimize the experiment plan. Through multiple teaching practice, and ponders unceasingly and consummates, we have obtained some improvement capriccioso of experiment. After combed, and put to utilize in this experiment teaching. The concrete mentality and plan shows in Figure 1.

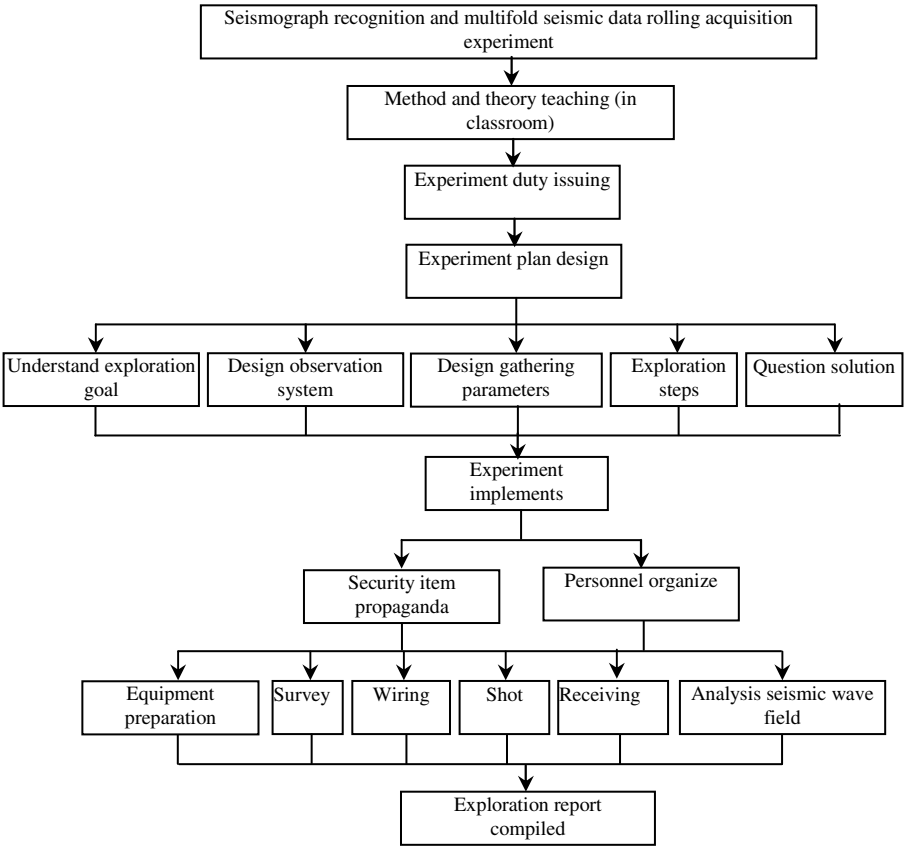

Fig. 1. "Seismograph recognition and multifold seismic data rolling acquisition experiment" plan

3.1 Classroom Teaching

Classroom teaching is the theory teaching, is the basic mode and the method of knowledge instruction. And theoretical knowledge is experiment foundation. So the experiment theoretical knowledge must be spoken permeable in classroom, only then there is the possibility to complete the experiment. This experiment's elementary

theory mainly includes the following several aspect content: Seismic wave dynamics, seismic wave kinematics, multifold trundle gathering technology, instrumentation equipment, data acquisition goal, field construction work, construction steps, and points for attention and so on.

3.2 Student Design the Gathering Plan

The experiment is the theory and the practice union process that the goal is enable student to master the knowledge nimbly, even achieves utilization. Therefore, teacher provides the essential improvement mentality, directs student to use the brains, let student design the gathering plan as far as possible. Is only like this then advantageous in stimulating the interest for student. The experiment plan design should include the following contents:

Understand exploration goal: After exploration duty issued, and before starting the experiment, we should collect geological material of experiment field and other geophysical prospecting material as far as possible, so that we can understand exploration duty deeply, thus direct observation system design.

Design observation system and gathering parameter: Under the precondition of understanding exploration goal, drawing layout chart, simultaneously determined gathering parameters (including trace interval, shot interval, offset, traces per shot, sampling rate, sampling points, fold number, exploisive pattern and so on).

Experiment steps: Before doing experiment, the steps must be clear certainly. Lets each students clear experiment procedure as far as possible. Simultaneously suggest that everybody supervises mutually. It is necessary that instruct teacher may violate some conventions intentionally and non-conventional wrong (for example start wiring before survey), and let students discover these mistakes. If they had not discovered that the teacher would design the reminded way carefully. The student memory will be more profound and the understanding will be thorough through such teaching way.

Question solution: There will possibly be some unexpected problems in the experiment process, such as the geophone bad, the source signal can not pass on the Seismograph and so on. There certainly must be one backup plan. For some common questions, the teacher might direct the students to supply ideas ahead. For some uncommon questions, the teacher certainly should know fairly well, and ensure the experiment to carry on smoothly as far as possible.

3.3 Experiment Implements

Once after the plan determined, the experiment might carry on officially. The goal of experiment is that make the student to understand the knowledge spot profoundly, master the knowledge, and exercise the practical ability. Therefore, each link must let the students operate personally in experiment process. This time, the duty of the instruct teacher is only direction. The contents including experiment equipment preparation, survey, wiring, shot and receive seismic wave, seismic wave field analysis. Certainly, because the students are many, the instrument is limited, the class

hours are few and the experimental duties are heavy. In this case, the instruct teacher must design elaborately, organize organically, can let the students complete the experimental duties effective highly.

The measure that we adopt is: Whole arrangement, rational division of labor, and let each student participate in the experiment. For example, the Instructional class are 4 classes at present. The concrete arrangement is: the 1st class is responsible for the surveying work. After the survey completes, the 2nd class is responsible to wire. The 3rd class is responsible to gather (Figure 2). After the experiment completes, the responsibly of the 4th class is receive the electric cable line. When carries on the correspondence link, the student does the experiment, at the same time, the teacher responses to explain, and other 3 classes stand observation (Figure 2b) with lining up nearby the survey line. In this process, if there is problem, the teacher may use the guiding model to teach, may also use the asking model to teach, in order to stimulate and use student's brains extremely, and improve education and study efficiency.

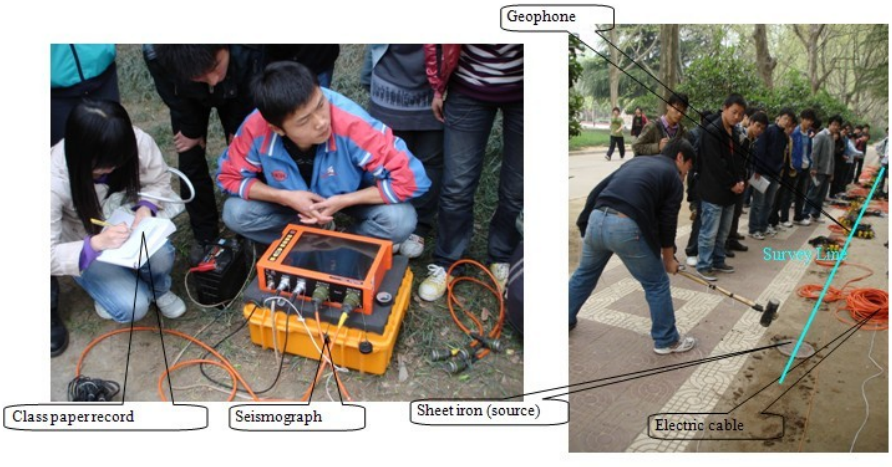

Fig. 2. The work field of multifold seismic data trundle gathering experiment, (a) seismic gathers and (b) stimulation seismic wave

3.4 Experiment Summarize

After the experiment, the students need to summarize promptly, can digest, absorb and grasp the knowledge well. This link mainly is compiles the experiment report, including summary experiment goal and content, basic theory, experiment steps, points for attention, seismic wave field analysis and understanding, harvests. Figure 3 is two shots seismic record which is this experiment obtains. The signal-to-noise ratio is high, and the wave field is rich (including refracted wave, reflected wave, surface wave and 50Hz electric cable wave). There is found the goal reflection layer (the reflected event nearby 50ms and 200ms). The students have completed the experimental duties splendidly, grasped the knowledge spot of experiment content.

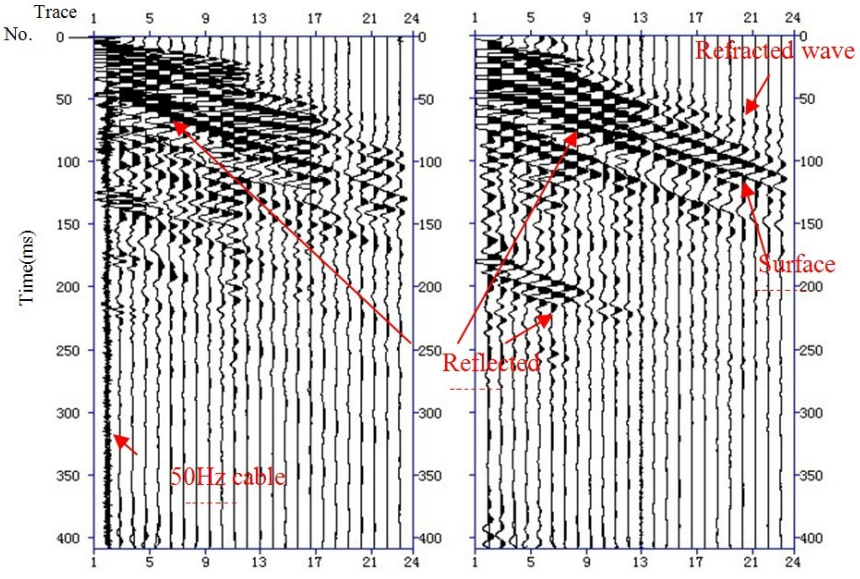

Fig. 3. The multifold seismic data trundle gathering experiment shot record. (a) 1st shot seismic record and (b) 10th shot seismic record

4 Conclusion

The plan optimization of "Seismograph recognition and multifold seismic data rolling acquisition experiment" is the reform and attempt of the seismic experiment class. Through the experiment plan optimized, we have obtained a good teaching effect as well as experiment. Although this is only one time of seismograph recognition and multifold seismic data rolling acquisition experiment with organized and system, and there are many aspects that still are worth improving and discussion, the students had still given a very high appraisal to this exploring experiment. After field data gathering, they took part in the indoor material in processing and explanation positively and enthusiastically. Through such experiment, the students feel generally that the theoretical knowledge in books has been no longer uninteresting and tasteless, and let they realize the pleasure of study. The experiment stimulated the study enthusiasm of student profoundly that turned the theoretical knowledge in textbook into the achievement that can be use for solving actual problem. It can be said that this "Seismograph recognition and multifold seismic data rolling acquisition experiment" is one time of reform and attempt for seismic experiment courses, we have received a good teaching effect.

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Comprehensive Automation Experiment Course Based on Wind Energy*

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Abstract. Comprehensive automation experiment course is high level course of experiment teaching for junior and senior students in automation major. In order to improve practice abilities of students in engineering, the course takes full advantage of resource of scientific research projects in wind energy field. The hardware and software of current projects in wind energy provide powerful platform. The platform makes that students have more opportunities to apply automation knowledge in practical engineering. It greatly improves students' abilities on engineering application.

Keywords: Comprehensive automation experiment, Wind energy, Experiment teaching, Practical skills orientated.

1 Introduction

As a university orientated with practical skills, Shanghai Dian Ji University (SDJU) focuses on the cultivation of students with strong practical skills and its key specialty is engineering. Shanghai Dian Ji University is one of three universities which are not under the direct administration of Ministry of Education of People's Republic China and Shanghai Municipal Education in Shanghai. It is under the direct administration of Shanghai Electric Group Co., Ltd., who is one of the largest diversified equipment manufacturing groups in China. The above special background makes Shanghai Dian Ji University has much closer relationship with local industries of Shanghai Electric Group Co. Ltd.. Shanghai Dian Ji University more emphasizes on training practical skills of students.

Automation is one subject which connects theory knowledge with practice. Especially for practical skills orientated universities, it is more important to teach students to master abilities of applying theoretical knowledge. As future engineers, students of automation major must learn how to use automation equipments skillfully. So it demands students should be familiar with different hardware and able to use corresponding software. Then university and teachers must provide enough hardware

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and software resource to satisfy above demand. The best way is to utilize existing resource from engineering projects who have done or been done. For Shanghai Dian Ji University, wind energy is one of most developed scientific research field in the whole university. The university has done a lot of engineering projects in wind energy field. Those projects provide plenty of experiments platform for teaching and researching work. And Shanghai Dian Ji University has good cooperation with wind energy companies in the Yangtze River Delta such as Shanghai Electric Wind Energy Equipment Co. Ltd.. In a word, developing comprehensive automation experiment course based on wind energy resource of university can satisfy demands from teachers, students and their future employer.

2 The Characteristic of Comprehensive Automation Experiment Course

For students of automation major, they really need some methods to apply basic control theory for example PID control algorithm after basic control theory study. Matlab, Mathematica and Maple etc. can help students understand those algorithms from mathematics aspect. But for students of practical skills orientated university, who are becoming to be future engineers, it is more important to know how to apply those algorithm in engineering. For Junior of automation major, they have learned theoretical knowledge about PLC, single chip controller, motor control, DSP and sensor etc. Now it is time for them to use those devices in some practical engineering. It is necessary to open a comprehensive experiment course. The course gives students to use all kinds of automation equipments in one project. The project is real engineering. All details of the project can teach students to deal with many problems which they will face in their future job after they have worked.

As current experiment condition, most laboratories for undergraduates are design for simplex object. Their equipments have single function and are simulation of certain practical engineering application. They can reflect basic theory but not the real one. Most students reflect that they still cannot connect those devices with engineering application in industry after those experiments such motor control, PLC control, single chip controller and DSP. So universities and teachers are facing great challenge to teach students really to know those devices, to teach them to really use those equipments in engineering without re-training from beginning. Then comprehensive automation experiment course can be summarized as:

- Synthesis
- Engineering
- Teachability

3 Wind Power with Shanghai Dian Ji University

Shanghai Dian Ji University is a public university which is focused on the cultivation of students with strong practical skills and its key specialty is engineering. Wind power is

one of most important and developed research fields of Shanghai Dian Ji University. In last five years, Shanghai Dian Ji University has undertaken and completed dozen of projects. Those projects come from National High Technology Research and Development Program (”863” Program) of China, National Natural Science Foundation of China, Natural Science Foundation of Shanghai and Science and Technology Commission of Shanghai. In wind power field of Shanghai Dian Ji University, there is one research group which is composed of nearly ten teachers, which is including two professors and six doctors. The most importance is that there are perfect experiment condition for research and teaching in wind power field. In last few years, more than seven million RMB has been used to build a perfect wind power laboratory. It is including hardware and software which cover all kinds of application of automation such as motor control, motion control, sensor technology, hydraulic control, electric and electrical control and pneumatic control etc with PLC, DSP and single chip controller. The wind power laboratory completed satisfied all demands of comprehensive automation experiment course in all aspects. Next, the basic knowledge of wind energy is introduced.

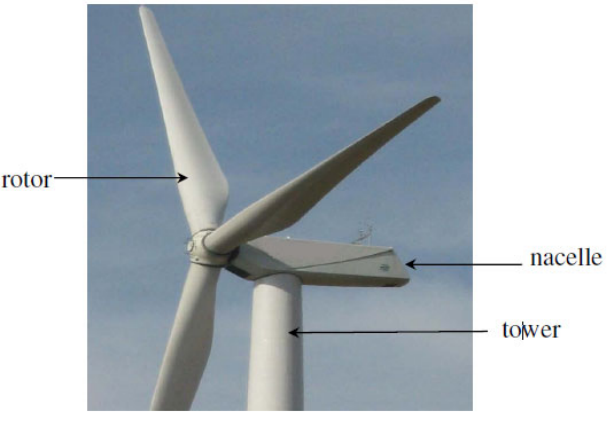

Fig. 1. Appearance of wind turbine

4 The Introduction of Wind Turbine

Wind turbine is a kind of complicated Mechanical and Electrical Equipment, especially for Megawatt wind turbine. From its appearance, wind turbine is made of rotor, nacelle and tower [1], as we see in figure 1. When wind turbine operates, wind drives rotor to turn. It makes wind energy transfer into mechanical energy. Rotor drives generator through drive train. Then generator produces electric power. The basic theory of energy transformation is followed as figure 2[2].

By far, there are two kinds of main wind generating technology [3]. One is Double-fed induction wind generator technology and another is direct-drive wind generator technology. Both of them are consisted of generator, control subsystem, hydraulic subsystem, pneumatic control subsystem and communication subsystem. Wind power system contains motor control, motion control, sensor technology, hydraulic control, electric and electrical control and pneumatic control etc., which represent for different engineering application of automation. In engineering practice of previous project, Shanghai Dian Ji University has carried out most of these subsystems. Composing these subsystems can get the whole wind turbine. Therefore students can learn system design and synthesis, different systems' function. The following will give different aspects in details.

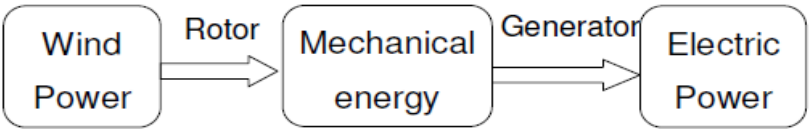

Fig. 2. Basic process of energy transformation

5 Motor Control

Motor is most popular control object in automation and engineering. Motor control is applied in every field of industry, agriculture, military, daily life. It is necessary for students of automation to know how to control motor. In wind energy laboratory of Shanghai Dian Ji University, there are several different motor control platform. In figure 3 and 4, they show two different motor. Both of them are small generating systems. Figure 3 shows that an AC induction servo motor drives a three-phase asynchronous motor. Figure 4 shows that a three-phase asynchronous motor drives permanent magnet synchronous generator. Both systems are controlled by a control system which is consisted of PLC, Frequency converter and inverter. According to learning, students can know basic process of motor control, power generating and frequency conversion.

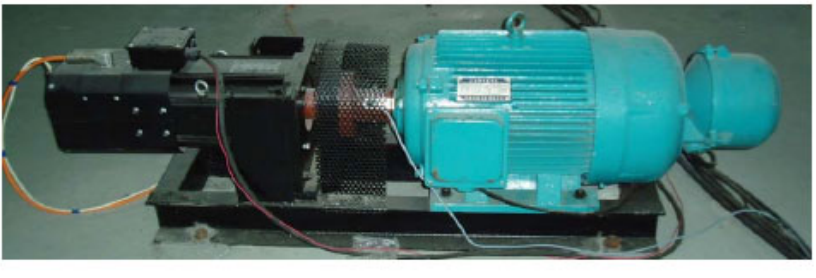

Fig. 3. Double-fed generating experiment platform

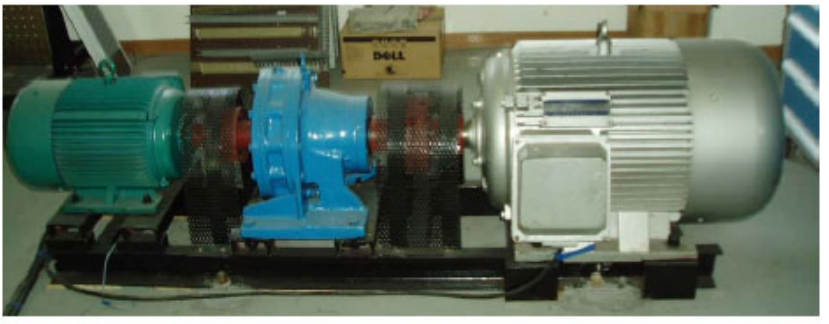

Fig. 4. Low-speed permanent magnetic synchronous experiment system

6 Motion Control

Motion control is an important engineering application in industry. It has requirement of precision and accuracy. Figure 5 is a small wind turbine rated of 7.5KW. The small wind turbine has yaw control and pitch control. Both of them are typical motion control. Yaw system and pitch system need rotate around corresponded fixed axis. Students can program to control position and direction of rotation according software in certain accuracy.

Fig. 5. Small experimental wind turbine

7 Sensor Technology

There are a lot of sensors in wind turbine as showed in figure 6. Those sensors collect the information of different assembly of wind turbine. The information is consisted of speed, temperature, pressure, current, voltage and vibration. According this information, control system can know working condition of wind turbine. It can insure safe operation of wind turbine. Using these sensors, students can learn knowledge of data acquisition, data transfer and data analysis [4].

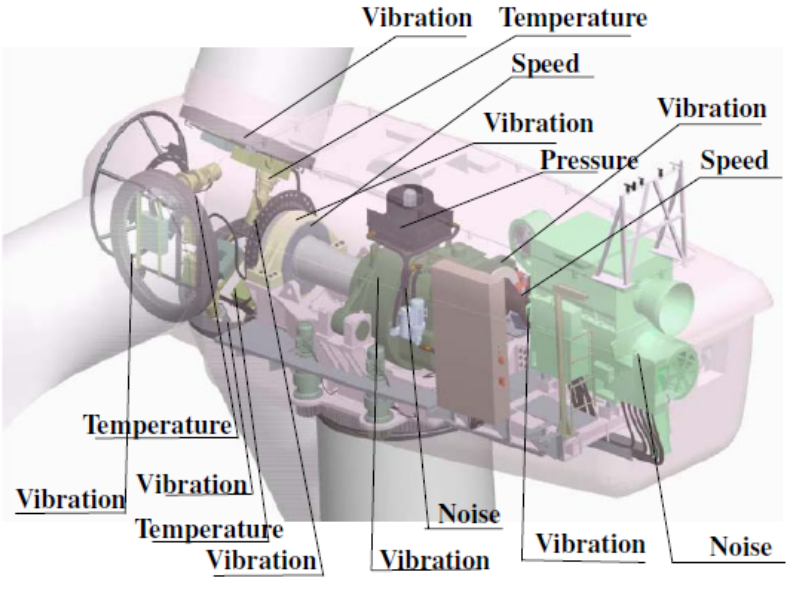

Fig. 6. Sensors of wind turbine

8 Hydraulic Control

Hydraulic system is key part for gearbox, generator, main shaft bearing, brake, cooler and other equipments who use liquid for lubrication and pressure. Even some pitch systems use hydraulic system as main power. The pipes of hydraulic system go through the whole wind turbine. The system has one hydraulic station showed in figure 7, which supplies the main pressure for these pipes.

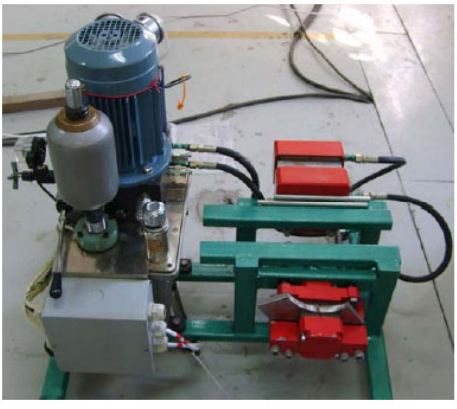

Fig. 7. Hydraulic system of wind turbine

9 Control System

In wind turbine, PLC is core of main control system. Main control system is brain of wind turbine. It collects information from sensors to know condition of environment and wind turbine. Then it sends command to Actuators in wind turbine to work. So main control system is not only made of hardware, but also software programmed in hardware. Figure 8 shows the control system of above small wind turbine. For control system of motor systems showed in figure 3 and 4, it is consisted of DSP and single chip controller. Students can use professional software to implement algorithms and strategy.

Fig. 8. Control cabinet of small wind turbine

10 Model Simulation of Wind Turbine

Actually, simulation of wind turbine model is also a good task for undergraduates. As we know, the basic mathematical formulation of wind turbine is following [6]:

$$P = \frac{1}{2}\rho C_p A v^3 \tag{1}$$

Here P is output power of wind turbine;
ρ is density of air;
A is area swept by wind rotor blades;
v is wind speed at blades;
C_p is the power coefficient.

Wind turbine is a complicated system including mechanical equipment, motors, generator, sensors, hydraulic devices and other equipment. Modeling the whole system from kinematics or energy aspect is a challenge. Simplifying in some degree is necessary. During modeling, students can know how to decompose a big system into several small subsystems. Every subsystem can be described by one or several mathematical equations. A basic hint can be given to students as showed in figure 9[5]. Plenty of researches have given good suggestion for modeling of wind turbine [7] [8]. Using Matlab software, students can make simulation model of wind turbine and verify accuracy of model.

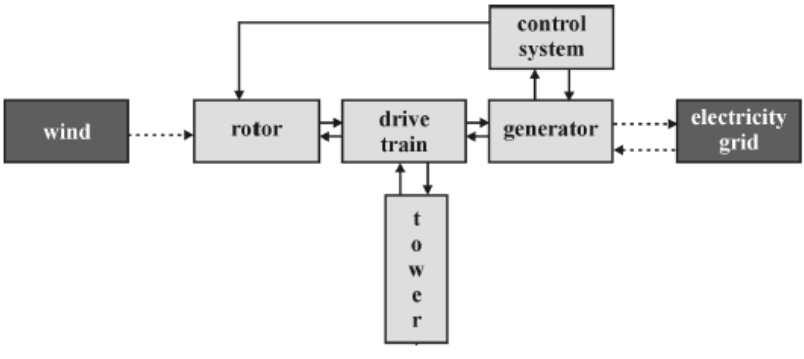

Fig. 9. Basic simulation model of wind turbine

11 Conclusion

Automation comprehensive experiment course is a very important course for students of automation major. After learning this course, students finally understand how to use theory knowledge which they have learned into engineering practice. It is the first step that students become future engineer. So this course must be very close to engineering practice and have enough industry objects. The wind energy laboratory is the exact one which satisfies above demand. The laboratory has all kinds of application of

automation such as motor control, motion control, sensor technology, hydraulic control, electric and electrical control and pneumatic control etc. with PLC, DSP and single chip controller. In last few years, more than two hundred students have learned automation comprehensive experiment course. For those who have graduated and worked, they say that every equipment they use in their jobs can be found in automation comprehensive experiment course. If they have studied harder before, they can master these tools more quickly right now. The feedback from students proves automation comprehensive experiment course based on wind energy is successful and satisfactory. In future, automation comprehensive experiment course will be improved constantly according engineering development and education requirement.

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Exploration and Practice to Constructing Electronics and Information Engineering Characteristic Specialty

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Abstract. Introduction of the provincial construction unit---concrete measures and achievements of professional construction for electronic and information engineering in Shenyang University of Technology. After analyzing the professional development, the construction target and ideas are put forward based on the construction of infrastructure and conditions. The reformation consists of these aspects: professional training program, constructing faculty, students' practical ability, innovative education and cultivate professional career planning and so on. The aim of the reformation is to improve the undergraduate talent training quality of electronic information engineering, ensure professional characteristics and promote the continuous professional development.

Keywords: Electronic and information engineering, Professional characteristics, Talents training, Professional construction.

1 Introduction

Electronic information technology is the development leading edge of information science. It is a symbol to evaluate the modernization level of a country and the comprehensive national strength, which is also an important symbol of China's high-tech development in the next twenty years. It is a complex and professional technical system and has extensive applicability and permeability in every field of national economy, not only brings a new crossover technology and new industry, but also create a new economic and social demand, that is the need of a number of electronic information technology talent who has the extensive knowledge, strong practice ability and innovation consciousness and innovative ability. Thus the electronic information technology which is the core of the subject of electronic information engineering bears the responsibility of cultivating high-quality talents[1,2]. In early 2007, the ministry of education launched the "high school education undergraduate teaching quality and teaching reform project" (referred to as quality engineering), which is an important measure of Chinese higher education, professional characteristics construction is the important content of "quality project " and the key to the survival and development of professional.[3].

Electronic information engineering belonged to Shenyang university of technology is the professional characteristics construction of Liaoning province, which center on

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the overall thinking of medium-term technological development plan in Liaoning province and make full use of the teaching reform and the achievement of course construction, perform the teacher's scientific research superiority positively and constantly improve the curriculum system reform so as to cultivate the informational innovative talents, all mentioned above make this professional has distinct characteristics and good development potential.

2 Historical Evolution and Current Situation

The electronic information engineering of Shenyang university of technology founded in 1986 was named as "application of electronic technology" in that time. Its specialty is weak electricity combined with strong electricity and both based on hardware and software. It is one of the specialties in electronic and information engineering discipline which started earlier in domestic. Since the establishment of the profession, the specialty had great progress and rapid development leaded by elder teachers. In 1997, “detection technology and automatic device” master was applied and approved in the next year, which made a new development opportunities and higher level of cultivating talents for electronic information engineering. In 1998, the higher schools undergraduate directory was promulgated by the state ministry of education. In which, electronic information engineering was unified which consisted of the original electronic engineering, application of electronic technology, information engineering, electromagnetic field and microwave technology, radio and television engineering, electronic and information engineering, wireless technology and information systems, electronic and information technology, photogrammetry and remote sensing (part), public security image technology[4]. According to the professional directory adjustment of national education, electronic information engineering in our school was transited directly by the application of electronic technology. Compared with the application of electronic technology, the electronic information engineering has undergone a fundamental change and which is a typical low professional. Therefore necessary reform has been finished on the basis of the original curriculum system, teaching contents and talent cultivation mode, which well adapt to the development of high-technology and meet the demand of the talent market. This specialty was selected as the demonstrative specialty construction of Shenyang university of technology in 2007. Over the past three years, after the actively exploring and hard practicing, deepen reform and strengthen management, this specialty has achieved remarkable results in the talent training scheme, teachers, teaching conditions, course construction and cultivating quality of students. The teaching quality is increasing year by year and the graduated students are praised and welcomed by the companies. The specialty is awarded the professional characteristics of Liaoning province. Now the students are nearly 600, 15% ~ 20% of them students are continue to study for a master's degree and employment keeps stable at 90% , many students have become the technology or management backbone in enterprises and institutions.

3 Overall Thinking of Characteristic Major Construction Selecting

Students of this major mainly study professional knowledge such as information acquirement, information processing, information transmission and information application. They not only master the basic theory of electronic technique and information processing, but also have a great ability to engineering practice, especially for the professional knowledge such as information acquirement and processing and industry process detection, whom also obtain a basic training of modern electronic technique and information acquirement and processing, the students are in capacity of researching, developing, designing and producing for information acquirement and processing system.

The assured major constructions based on the above training destination are as follows: Deepen the reformation of course system, teaching content and methods; make the utmost efforts to achieve teaching destination accord with the employment requirement; the teaching content held a lead by skill; teaching keystone placed by ability training; teaching activities formed by students; teaching organization led by the teachers; teaching quality standardized by practice ability training. The major is focus on training application-type technical talent whom with “proper theoretical principle, reasonable knowledge structure, strong practice ability and high comprehensive quality” so as to meet the needs of applied technology talents of production, administration and service. Then the training mode of “knowledge coordinates with the ability training, theory teaching compromises with practice, inside teaching interact with outside” will be formed.

The overall thinking of characteristic major construction is as follows:

(1) Summarize and analyze the current characteristic, find the gap by contrast with destination, seek the unity of thinking and form an air of innovation.

(2) Construct a characteristic with the features of the times, pay attention to the system of knowledge structure, the three-dimensional multi-layer training plan of professional integrated by science and technology and talent cultivation system.

(3) Strengthen education teaching reform and update the education concept, form the teaching faculty with stronger research ability, higher level education and the optimal structure of teachers.

(4) Strengthen the guidance and improve students' interest in study specialized knowledge, pay attention to individual character development of student so as to cultivate diverse talents.

4 The Construction Measures and Achievements

4.1 Perfect the Professional Training Program, Adjust and Optimize Curriculum System

Following the principle of "thick foundation, broad caliber, high quality" and on the basis of research demonstrates as "questionnaire - visit - contrast - research demonstration", after studying the professional structure and curriculum system construction of electronic information engineering, the research of this professional

knowledge, professional direction, teaching mode and the course structure have been discussed in this paper so as to establish the correct revision teaching plan. In addition, the criterion of "generous", "theory of hierarchical" course system based on employment-oriented and innovation which not only meets the requirement of reform and development in colleges, but also meets the requirement of our existing running conditions and students' level. This major pay attention to the basic knowledge, consolidate the students' theory basis and extend their vision and discipline. The theory course teaching system is "3 basic platform + 1 module", which means the platform is based on three levels such as general basis, discipline basis and professional basis, the module is on the basis of professional direction. (show as figure 1).

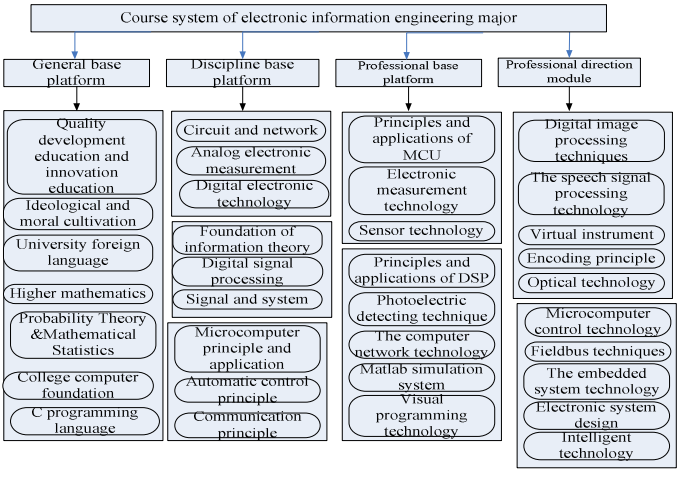

Fig. 1. Diagram of electronic information engineering course system

Table 1. Credits and hours distribution table of electronic information engineering

Course nature	Credits	Hours
The public basic course	59.5	952
Discipline basic course	56	896
Specialized course	19	304
Practice teaching	41	
Quality development education and innovation education	20	160

School assignment is shown as table 1. The total hours of course are 2312 hours, core course and elective course is 2200 hours. The ratio of basic course and professional course is 6.07:1, the ratio of core course and elective course is 6.07:1, and ration of theory credit and practice teaching credit is 3.28:1 (excluding extracurricular activities in science and technology), and practice credits (practice+

experimental +computer) are 35.2% of the total credits, elective credits is 17.3% of the total credits.

4.2 The Organic Combination of Teaching and Scientific Research, Strengthen the Quality Construction of Teachers Team

The policy as "one key, one emphasis, one advantage" is persisted and teacher training is strengthened so as to improve the comprehensive ability of professional teachers. One key means to strengthen the change of teaching. One emphasis means to strengthen the training of the leader and young teachers. One advantage means to establish a team constituted by middle aged and young teachers whom have strong responsibility and rich innovation spirit by use of the features of many young teachers. The specific measures are as follows: encourage the in-service teachers to go further education and obtain the degree and improve the degree and level of in-service teachers. Meanwhile establish the academic report system that is the professional teachers with senior professional titles give an academic report annually within the major field. Organize professional teachers to take part in seminars regularly. "Go out" –organize the professional teachers to visit and attend the seminars. "Come in" - invite experts from outside to do academic communications.

The key factor of forming specialty is scientific research. Because the teachers' scientific research will bring a certain social influence, the influence will be recognized by the society when it reaches a certain degree. Although only the scientific research is recognized, it will produce profound social significance and meanwhile the teachers' scientific research will affect the teaching plan and implementation. Thus the research team should be established, research subjects should be applied, and the domestic and international academic communication will be attended. Then rich teachers' practical experience with the scientific research project, drive educational reform by scientific research and promote scientific research by educational reform. The students will become more suitable for the social by enhancing teaching research and reform.

Study out all kinds of education reforms. We also need to keep exploring on the course setting, teaching contents, teaching methods, construction of laboratories, contents and methods of laboratories and choice of teaching material. Teachers are encouraged to join in the reform practices. They need to teach students to take part in the research training so that the students could have "solid knowledge, the ability of learning and practicing on themselves". Then the students may adjust to the rapid development of electronic information technology and meet the demands of the society.

The basic task is to establish a teaching team with reasonable construction and the teamwork spirit. In the teaching team, the academic foregoers are the core, and young teachers with doctor degrees and high academic level are the main body. We have trained one brand-class teacher in Liaoning province, two teachers of the top 100 in Liaoning province, one innovation team in Liaoning province, a young core teacher at the level of the province and one at the level of school from 2007 to 2009. A team based on powerful middle-aged young teachers with the innovation spirit has been built up.

The overall objectives of the professional is aiming at the international academic frontiers, paying attention to the original application, outstanding achievements in research, promoting the interdisciplinary and training high quality talent. After the construction nearly for 10 years, stable and featured professionals have been formed which include the imaging detection technology, precision measurement and sensing technology, photoelectric detection and information fusion technology, intelligent measurement optimization technology and so on. Nearly three years the professional have received six research awards and declared nine invention patent. The professional have obtained one invention patent license and transferred 12 outcomes. The professional obtains three national natural science funds and three provincial natural science funds. The scientific takings are nearly 14 million in recent five years. 238 academic articles have been published including 96 articles indexed by SCI, EI and ISTP.

The professional teachers have advance teaching idea and education concept and reform teaching actively. They have achieved remarkable results and received widespread high praise. In recent years they obtain 17 prizes for a variety of teaching achievement, including once first prize of provincial teaching achievement and twice times the third prize of provincial teaching achievement, and one concluding project of the ministry of education, five times of Shenyang University of Technology achievements. There are 10 items in current educational reform project, including 3 items for class A of Liaoning province and 4 items for school key project. 2 courses are provincial fine-selected and 4 courses are school courses. 7 teaching material have been published formal, which include three high-quality textbooks of Liaoning province.

4.3 Open Up Various Path, Cultivate Students of Innovate Ability

1) Treasure the practice teaching and construct relative independent individual experimental teaching system proceed from the practical hands-on ability and the technology practice ability. In the teaching program, the practice teaching is divided into experiment, course project, internship, graduation project and the outdoor creative technology activities. Experiment link is reasonably arranged and experiment equipment meets the teaching demanding. 18 experiment course and 93 experiment project are set up in the major, and the comprehensive, designable, creative course is account for 93.3% of total experiment course; the project of comprehensive, designable, creative experimental is account for 90% of total projects. Specialty experiments are 100% comprehensive experiments and taken as regional class style. The practice ability of students will be obviously improved during the teaching process.

2) Establish the base of science and technology activities, supply the site of science and technology experiment.

Experimental teaching center is a main base of experimental teaching for students. Currently the central equipment has a property of 30 million, which assumes the experiment, course project and graduation project. The laboratory carries out an open management which consists of 8 laboratories (29 locellus), 1 innovation lab, 1 internship base, 2 university key Labs of Liaoning province and 2 labs united with USA. In order to provide the outdoor creative technology activities condition, a

college student innovation lab had been established in 2003, then extended again as a science and technology activities base in 2008. For the purpose of coordinating the science and technology activities, a science contest is held each semester so as to build a good atmosphere of innovation.

3) Encourage some students to join the teacher's project so as to cultivate their scientific thinking, enhance their practical problem solving ability and team spirit and raise the engineering practice ability.

4) Positively encourage, organize and guide the students to join the electronic design contest of national and Liaoning. In order to improve the independent comprehensive designed capacity for students, from plan selection, hardware composition, arithmetic design, software programming to debugging successfully, the students are demanded to achieve the plan, the design of software and hardware, and the system debugging independently so as to track the development of electrical information engineering. Students got good results in electronic design contest over the past years. Since 2005, students have awarded twice of the first prize of Nation, fourth times of second prize of Nation, ninth times of grand prize of province and some other prizes.

4.4 Some Common Mistakes to Enhance Professional Education and Career Planning, Establish a "Mentor Group"Training Mode

In order to ensure the quality of personnel training, the teachers guide the student to finish enrollment and establish a reasonable knowledge structure, make career planning and establish a "mentor group" training mode. Fully mobilize the enthusiasm of all the professional teachers, each class is provided mentor group including four or five Professors, associate professors, lecturers on basis of the research and title structure. Mentor group is charged by professors, organizing communication and research activities are held periodically. From the beginning of grade 2, students and teachers establish counseling relationship, the tutors should acquaint with students deeply and guide the students determine the direction accurately based on personality characteristics of the student. Courses structural integrity and internal relations are focused and a reasonable knowledge structure is established so as to achieve the correct course selection. At the same time let the students go into the professional laboratory, understand the direction and characteristics of professional development, know the research orientation and research projects of teachers, participate in research seminars and academic reports periodically and create a favorable academic atmosphere. From the beginning of grade 3, some outstanding students participate in the research activities of teachers to finish a professional research and experimental research topics. These students will participate in various scientific and technological innovation contests under the guidance of the teachers. General students will attend the science and technology seminars, science and technology seminars of teachers', design small production of a simple system. Fourth grade students are guided by the teachers to finish the career guidance, complete the design, papers, patents and other forms of research results so as to prepare fully to go to the society.

5 Summary and Prospect

After years of efforts, the construction of electronic information in Shenyang university technology has achieved good effects. However, there are still many aspects need further improvement:

1) We should continue to strengthen the training of the teacher team and the key teachers, develop more effective incentives policy for the growth of young teachers, and accelerate train the practical ability and scientific research abilities of young teachers to improve the overall quality of the young teachers.

2) We should continue to strengthen the construction of teaching practice, on the one hand we should develop more teaching content as far as possible under the existing conditions, organize students to have relative trainings; on the other hand, we should continue to improve the management system, realize the open management of various hardware resources step by step to improve their practice ability.

3) We should strengthen the building of training base outside the campus, and further extend the combination of engineering and school, school and enterprise cooperation channels and enhance the capacity of students to serve for the community.

Professional development is a systems engineering, so we have a long way to go. Maintaining features and achieving sustainable development are the problems that all teachers will always continue to seriously consider and explore.

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Exploiting Ontology Reasoning in E-learning*

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Abstract. Semantic Web technologies are promising for realizing e-learning environments. Ontologies play a core role in such technologies. Though OWL becomes the standard language to model ontologies, it is unclear yet how to make the best of established ontology reasoning techniques coming with OWL to support e-learning. Hence, this paper studies how to exploit ontology reasoning techniques coming with OWL in e-learning environments. Case studies demonstrate the usefulness of these techniques in providing e-learning facilities where the semantic correctness is guaranteed.

Keywords: E-learning, Semantic Web, Ontology Reasoning, OWL, Description Logics.

1 Introduction

The use of the World Wide Web (WWW) has progressed from the augmentation of conventional courses to a newer form of WWW-based education, *e-learning* [1]. E-learning aims at replacing traditional time/place/content predetermined learning with just-in-time/at-work-place/personalized learning. This aim is hard to be reached by current WWW-based solutions due to pitfalls such as information overload and lack of machine-understandable information.

The new generation of WWW, Semantic Web (SW) [2], constitutes an environment in which Web data are semantics-enriched and machine-understandable. SW technologies have been frequently discussed and become promising technologies for realizing e-learning environments [3,4,5,6]. The primary characteristics of SW technologies, namely shared understanding, is based on ontologies. An ontology is a set of knowledge terms, including the vocabulary, the semantic interconnections, and some simple rules of inference and logic for some particular topic [7]. Ontologies enable the organization of learning materials around small pieces of semantically annotated learning objects [3]. The W3C organization proposed the standard Web Ontology Language (OWL) [8] to model ontologies. OWL is based on Description Logics [9], which are logical languages with formal semantics.

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There exist several projects using ontologies to support e-learning. The OMNIBUS project provides a framework for building ontology-based instructional systems [10] and develops a heavyweight ontology called the OMNIBUS ontology [11]. The ontology is based on philosophical consideration of all the concepts necessary for understanding learning, instruction and instructional design. The O4E project develops a Web portal for classifying and annotating e-learning relevant research publications and successful practices [12]. The portal is based on a lightweight ontology called the O4E ontology. The LT4eL project integrates semantic knowledge to enhance the management, distribution and retrieval of learning materials [13]. It develops a domain ontology to facilitate semantic search and reusability of learning objects. The above projects have not made the best of the following ontology reasoning techniques that come with OWL.

- *Conjunctive Query Answering* [14,15]: retrieving information from an ontology according to user request. This technique can be used to retrieve learning objects that are semantically annotated.
- *Justification Finding* [16] (also called *Axiom Pinpointing* [17]): computing explanations to show why some information holds in an ontology. This technique can be used to explain why a learning object satisfies the retrieval request, why the principle of learning and instruction is inconsistent, etc.
- *Abductive Reasoning* [18]: computing explanations to show why some information does not hold in an ontology. This technique can be used to explain why a learning object cannot be retrieved, why a learning/instructional process cannot achieve a specific goal, etc. It can also be used to rank learning objects based on their distances to the retrieval request, to suggest extra resources to achieve a goal, etc.

All projects mentioned above exploit similar techniques as conjunctive query answering to retrieve learning objects. But since the retrieval process exploited is ad hoc and may not follow a formal semantics, the retrieval results may not be semantically sound and complete. On the other hand, only the MINIBUS project exploits similar techniques as justification finding and abductive reasoning to support explanations about interpretations of learning/instructional processes or problems in achievement of specific goals [11]. These techniques, however, are also ad hoc and may not follow a formal semantics, thus they may not guarantee the semantic correctness. Moreover, recent surveys on SW-based e-learning e.g. [5,6] also do not mention how to exploit conjunctive query answering, justification finding or abductive reasoning to support e-learning. Hence, this paper studies how to exploit the above techniques in e-learning environments. Case studies are given in section 3 while some challenging problems are given in section 4.

2 Preliminaries

The Web Ontology Language (OWL) comes with three species, OWL Lite, OWL DL and OWL Full, with increasing expressivity. We only introduce the syntax and semantics of OWL DL because OWL DL covers OWL Lite and OWL Full

Table 1. The syntax and semantics of OWL DL

Constructors	Semantics	Constructors	Semantics
$\top$	$\Delta^{\mathcal{I}}$	$\bot$	$\emptyset$
$\{a\}$	$\{a^{\mathcal{I}}\}$	$\neg C$	$\Delta^{\mathcal{I}} \setminus C^{\mathcal{I}}$
$C \sqcap D$	$C^{\mathcal{I}} \cap D^{\mathcal{I}}$	$C \sqcup D$	$C^{\mathcal{I}} \cup D^{\mathcal{I}}$
$\exists R.C$	$\{x \mid \exists y : (x,y) \in R^{\mathcal{I}}, y \in C^{\mathcal{I}}\}$		
$\forall R.C$	$\{x \mid \forall y : (x,y) \in R^{\mathcal{I}} \rightarrow y \in C^{\mathcal{I}}\}$		
$\geq_n S$	$\{x \mid \lvert\{y \mid (x,y) \in S^{\mathcal{I}}\}\rvert \geq n\}$		
$\leq_m S$	$\{x \mid \lvert\{y \mid (x,y) \in S^{\mathcal{I}}\}\rvert \leq m\}$		

Axiom Name	Syntax	Semantics
concept inclusion axiom	$C \sqsubseteq D$	$C^{\mathcal{I}} \subseteq D^{\mathcal{I}}$
role inclusion axiom	$R_1 \sqsubseteq R_2$	$R_1^{\mathcal{I}} \subseteq R_2^{\mathcal{I}}$
transitivity axiom	Trans(R)	$R^{\mathcal{I}} \times R^{\mathcal{I}} \subseteq R^{\mathcal{I}}$
concept assertion	$C(a)$	$a^{\mathcal{I}} \in C^{\mathcal{I}}$
role assertion	$R(a,b)$	$(a^{\mathcal{I}}, b^{\mathcal{I}}) \in R^{\mathcal{I}}$
equality assertion	$a \approx b$	$a^{\mathcal{I}} = b^{\mathcal{I}}$
inequality assertion	$a \not\approx b$	$a^{\mathcal{I}} \neq b^{\mathcal{I}}$

is undecidable and seldom used in practice. OWL DL corresponds to Description Logic (DL) $\mathcal{SHOIN}$, which is a decidable fragment of first-order logic [8]. Though OWL DL also contains datatypes, we do not complicate our presentation by considering them here. We use the DL syntax [9] to represent OWL DL as it is more compact.

An OWL DL *vocabulary* consists of a set N_C of *atomic concepts*, a set N_R of *atomic roles*, and a set N_I of *individuals*. A *role* is either an atomic role $r \in N_R$ or an *inverse role* r^- with $r \in N_R$. By R^- we denote the *inverse* of a role R, defined as r^- when $R = r$, and r when $R = r^-$.

The set of OWL DL concepts is recursively defined using atomic concepts $A \in N_C$ and the constructors given in Table 1, where C, D are concepts, R, S roles, a, b individuals, and n, m positive integers. An ontology $\mathcal{O}$ is a set of axioms specified in Table 1, where concept/role inclusion axioms and role transitivity axioms constitute the *TBox* of $\mathcal{O}$, and concept/role assertions and equality/inequality assertions constitute the *ABox* of $\mathcal{O}$. A role R is *transitive* (in $\mathcal{O}$) if Trans(R) $\in \mathcal{O}$ or Trans(R^-) $\in \mathcal{O}$. Let $R_1 \sqsubseteq_{\mathcal{O}} R_2$ be the smallest transitive reflexive relation between roles such that $R_1 \sqsubseteq R_2 \in \mathcal{O}$ implies $R_1 \sqsubseteq_{\mathcal{O}} R_2$ and $R_1^- \sqsubseteq_{\mathcal{O}} R_2^-$. For any concept of the form $\geq_n S.C$ and $\leq_m S.C$ in $\mathcal{O}$, the role S is required to be *simple*, i.e., there is not any transitive role R such that $R \sqsubseteq_{\mathcal{O}} S$.

The semantics of OWL DL is defined using interpretations. An *interpretation* $\mathcal{I} = (\Delta^{\mathcal{I}}, \cdot^{\mathcal{I}})$ consists of a *domain* $\Delta^{\mathcal{I}}$ and a function $\cdot^{\mathcal{I}}$ that maps every $A \in N_C$ to a set $A^{\mathcal{I}} \subseteq \Delta^{\mathcal{I}}$, every $r \in N_R$ to a binary relation $r^{\mathcal{I}} \subseteq \Delta^{\mathcal{I}} \times \Delta^{\mathcal{I}}$, and every $a \in N_I$ to $a^{\mathcal{I}} \in \Delta^{\mathcal{I}}$. The interpretation is extended to roles by defining $(r^-)^{\mathcal{I}}$ as $\{(x,y) \mid (y,x) \in r^{\mathcal{I}}\}$ and to concepts according to Table 1, where $|S|$ denotes the

cardinality of a set S. An interpretation $\mathcal{I}$ *satisfies* an axiom α if the respective condition to the right of the axiom in Table 1 holds; $\mathcal{I}$ is a *model* of an ontology $\mathcal{O}$ if $\mathcal{I}$ satisfies every axiom in $\mathcal{O}$. We say that $\mathcal{O}$ is *consistent* if it has a model; $\mathcal{O}$ *entails* a *formula* ϕ, denoted by $\mathcal{O} \models \phi$, if all models of $\mathcal{O}$ are also models of ϕ, where a formula is a connection of first-order atoms using and/or relations and existential/universal quantifiers.

3 Exploiting Ontology Reasoning Techniques

We use the following example in all our case studies.

Example 1. Let $\mathcal{O}$ be an artificial ontology which models some learning objects. The TBox of $\mathcal{O}$ consists of five axioms (1) $\mathsf{Paper} \sqsubseteq \leq_1 \mathsf{pubVenue}$ (*a paper is published in at most one venue*), (2) $\mathsf{Paper} \sqsubseteq \leq_1 \mathsf{pubYear}$ (*a paper is published in at most one year*), (3) $\mathsf{Paper} \sqsubseteq \exists \mathsf{author.Person}$ (*a paper has some authors that are persons*), (4) $\mathsf{Conference} \sqsubseteq \mathsf{Venue}$ (*conferences are venues*), and (5) $\mathsf{Journal} \sqsubseteq \mathsf{Venue}$ (*journals are venues*). The ABox of $\mathcal{O}$ consists of ten axioms
(1) $\mathsf{Paper}(\mathsf{Semantic\_ELearning})$, (2) $\mathsf{pubVenue}(\mathsf{Semantic\_ELearning}, \mathsf{ISWC})$,
(3) $\mathsf{Conference}(\mathsf{ISWC})$,
(4) $\mathsf{pubVenue}(\mathsf{Semantic\_ELearning}, \mathsf{International\_Semantic\_Web\_Conference})$,
(5) $\mathsf{Renowned}(\mathsf{International\_Semantic\_Web\_Conference})$,
(6) $\mathsf{Paper}(\mathsf{The\_Educational\_Semantic\_Web})$,
(7) $\mathsf{pubVenue}(\mathsf{The\_Educational\_Semantic\_Web}, \mathsf{JETS})$,
(8) $\mathsf{Journal}(\mathsf{JETS})$, (9) $\mathsf{Renowned}(\mathsf{JETS})$, and
(10) $\mathsf{pubYear}(\mathsf{The\_Educational\_Semantic\_Web}, 2004)$.

3.1 Conjunctive Query Answering

Conjunctive query answering [14,15] is a basic ontology reasoning technique coming with OWL, which is used to retrieve information from an OWL ontology according to a conjunctive query. A conjunctive query (CQ) is of the form $q(\boldsymbol{x}) \leftarrow \exists \boldsymbol{y}.\mathsf{conj}(\boldsymbol{x}, \boldsymbol{y}, \boldsymbol{c})$, where $q(\boldsymbol{x})$ is the *head* of q, $\mathsf{conj}(\boldsymbol{x}, \boldsymbol{y}, \boldsymbol{c})$ is the *body* of q, $\boldsymbol{x}$ are *distinguished variables*, $\boldsymbol{y}$ are *non-distinguished variables*, $\boldsymbol{c}$ are individuals, and $\mathsf{conj}(\boldsymbol{x}, \boldsymbol{y}, \boldsymbol{c})$ is an and-relation of first-order atoms of the form $A(v)$ or $R(v_1, v_2)$ for A an atomic concept, R an atomic role, and v, v_1 and v_2 variables in $\boldsymbol{x}$ and $\boldsymbol{y}$ or individuals in $\boldsymbol{c}$ [15]. A tuple $\boldsymbol{t}$ of individuals in an ontology $\mathcal{O}$ is called an *answer* of $q(\boldsymbol{x})$ in $\mathcal{O}$ if $\mathcal{O} \models q[\boldsymbol{x} \mapsto \boldsymbol{t}]$, i.e., $\mathcal{O}$ entails the body of q with every variable in $\boldsymbol{x}$ substituted by its corresponding individual in $\boldsymbol{t}$. Conjunctive query answering is formally defined below.

Definition 1 (Conjunctive Query Answering). *Given a CQ* $q(\boldsymbol{x}) \leftarrow \exists \boldsymbol{y}.\mathsf{conj}(\boldsymbol{x}, \boldsymbol{y}, \boldsymbol{c})$ *upon an ontology* $\mathcal{O}$*, the problem of* conjunctive query answering *is to compute the set of all answers of* $q(\boldsymbol{x})$ *in* $\mathcal{O}$*.*

For instance, when we want to retrieve all papers that are published in renowned venues from the ontology $\mathcal{O}$ given in Example 1, we can pose a CQ $q(x) \leftarrow \exists y.\mathsf{Paper}(x) \wedge \mathsf{pubVenue}(x, y) \wedge \mathsf{Venue}(y) \wedge \mathsf{Renowned}(y)$ upon $\mathcal{O}$. The papers retrieved are Semantic_ELearning and The_Educational_Semantic_Web since they are the only papers in $\mathcal{O}$ and $\mathcal{O}$ entails both $\mathsf{Paper}(\mathsf{Semantic\_ELearning}) \wedge \mathsf{pubVenue}(\mathsf{Semantic\_ELearning}, \mathsf{ISWC}) \wedge \mathsf{Venue}(\mathsf{ISWC}) \wedge \mathsf{Renowned}(\mathsf{ISWC})$ and $\mathsf{Paper}(\mathsf{The\_Educational\_Semantic\_Web}) \wedge \mathsf{pubVenue}(\mathsf{The\_Educational\_Semantic\_Web}, \mathsf{JETS}) \wedge \mathsf{Venue}(\mathsf{JETS}) \wedge \mathsf{Renowned}(\mathsf{JETS})$. Note that axioms $\mathsf{Renowned}(\mathsf{ISWC})$, $\mathsf{Venue}(\mathsf{ISWC})$ and $\mathsf{Venue}(\mathsf{JETS})$ are not explicitly asserted in $\mathcal{O}$ but entailed by $\mathcal{O}$ through axioms in the TBox of $\mathcal{O}$. Thus, if we directly match the CQ to explicit axioms in $\mathcal{O}$, we cannot get complete results.

This example shows that conjunctive query answering is suitable for retrieving learning objects that are semantically annotated. The retrieval results are semantically sound and complete. This is an advantage in contrast to most of current techniques for retrieving learning objects.

3.2 Justification Finding

Justification finding [16] (also called *Axiom pinpointing* [17]) is a promising ontology reasoning technique, which is used to explain why some information holds in an ontology. More precisely, the problem of justification finding in an ontology $\mathcal{O}$ is to compute some/all minimal subsets of axioms in $\mathcal{O}$ that are responsible for a given formula, formally defined below.

Definition 2 (Justification Finding). *Given a formula ϕ upon an ontology $\mathcal{O}$, a* justification *of ϕ in $\mathcal{O}$ is a subset $\mathcal{O}_s$ of axioms in $\mathcal{O}$ such that $\mathcal{O}_s \models \phi$ and $\mathcal{O}'_s \not\models \phi$ for all proper subsets $\mathcal{O}'_s$ of $\mathcal{O}_s$. The problem of* justification finding *is to compute some/all justifications of ϕ in $\mathcal{O}$.*

For instance, when we want to explain why the conference ISWC is renowned based on the ontology $\mathcal{O}$ given in Example 1, we can compute the justifications of $\mathsf{Renowned}(\mathsf{ISWC})$ in $\mathcal{O}$. There is only one such justification, i.e. the set of axioms $\mathcal{O}_s = \{\mathsf{Paper} \sqsubseteq \leq_1 \mathsf{pubVenue}$, $\mathsf{Paper}(\mathsf{Semantic\_ELearning})$, $\mathsf{pubVenue}(\mathsf{Semantic\_ELearning}, \mathsf{ISWC})$, $\mathsf{pubVenue}(\mathsf{Semantic\_ELearning}, \mathsf{International\_Semantic\_Web\_Conference})$, $\mathsf{Renowned}(\mathsf{International\_Semantic\_Web\_Conference})\}$, because $\mathcal{O}_s$ entails $\mathsf{Renowned}(\mathsf{ISWC})$ and any proper subset of $\mathcal{O}_s$ does not.

Besides being used to explain why a learning object satisfies the retrieval request, justification finding can also be used to explain learning/instructional scenarios. Mizoguchi et al. [11] divided the explanation cases for learning/instructional scenarios into two types: one is interpretative cases, the other is suggestive cases. Justification finding is suitable for the interpretative cases, such as explaining why an event is preparation of another event. It can also be used in some suggestive cases, such as explaining why the principle of learning is inconsistent with the principle of instruction (the explanations can be used to suggest repair solutions using techniques proposed e.g. in [19]).

3.3 Abductive Reasoning

Abductive reasoning [18] is another promising ontology reasoning technique, which is used to explain why some information does not hold in an ontology. More precisely, the problem of abductive reasoning in an ontology $\mathcal{O}$ is to compute some/all sets $\mathcal{O}_s$ of axioms such that $\mathcal{O} \cup \mathcal{O}_s$ is consistent and $\mathcal{O} \cup \mathcal{O}_s$ entails a given formula, formally defined below. This definition corresponds to the notion of consistent knowledge base abduction [18], and coincides with the notion of traditional logic-based abduction [20].

Definition 3 (Abductive Reasoning). *Given a formula ϕ upon an ontology $\mathcal{O}$, an* abductive explanation *of ϕ in $\mathcal{O}$ is a set $\mathcal{O}_s$ of axioms such that $\mathcal{O} \cup \mathcal{O}_s$ is consistent and $\mathcal{O} \cup \mathcal{O}_s \models \phi$. The problem of* abductive reasoning *is to compute some/all abductive explanations of ϕ in $\mathcal{O}$.*

For instance, when we want to explain why the paper Semantic_ELearning may not be published in a 2004 conference according to the ontology $\mathcal{O}$ given in Example 1, we can compute the abductive explanations of $\exists y.\mathsf{pubVenue}(\mathsf{Semantic\_ELearning}, y) \wedge \mathsf{Conference}(y) \wedge \mathsf{pubYear}(\mathsf{Semantic\_ELearning}, 2004)$. One abductive explanation is $\{\mathsf{pubYear}(\mathsf{Semantic\_ELearning}, 2004)\}$, which means that the paper must be published in a 2004 conference if we know that it is published in year 2004.

Abductive reasoning can also be used to measure the distance between a learning object and a user query, and to rank learning objects for answering a query. Given a CQ $q(\boldsymbol{x}) \leftarrow \exists \boldsymbol{y}.\mathsf{conj}(\boldsymbol{x}, \boldsymbol{y}, \boldsymbol{c})$ in an ontology $\mathcal{O}$, the *distance* between a possible answer, i.e. a tuple of individuals, $\boldsymbol{t}$ and the CQ in $\mathcal{O}$, denoted by $\mathsf{dist}(\boldsymbol{t}, q(\boldsymbol{x}), \mathcal{O})$, can be defined as the minimal weight of abductive explanations of $q[\boldsymbol{x} \mapsto \boldsymbol{t}]$ in $\mathcal{O}$, where the weight of an abductive explanation can be defined as the sum of weights of axioms in the explanation; i.e., $\mathsf{dist}(\boldsymbol{t}, q(\boldsymbol{x}), \mathcal{O}) \stackrel{def}{=} \min\{\mathsf{weight}(E) \mid E \text{ is an abductive explanation of } q[\boldsymbol{x} \mapsto \boldsymbol{t}] \text{ in } \mathcal{O}\}$ and $\mathsf{weight}(E) \stackrel{def}{=} \sum_{\alpha \in E} \mathsf{weight}(\alpha)$.

For instance, given a CQ that asks for all papers published in a 2004 conference, i.e. $q(x) \leftarrow \exists y.\mathsf{Paper}(x) \wedge \mathsf{pubValue}(x, y) \wedge \mathsf{Conference}(y) \wedge \mathsf{pubYear}(x, 2004)$, upon the ontology $\mathcal{O}$ given in Example 1, we can compute two distances $\mathsf{dist}(\mathsf{The\_Educational\_Semantic\_Web}, q(x), \mathcal{O})$ and $\mathsf{dist}(\mathsf{Semantic\_ELearning}, q(x), \mathcal{O})$ for two possible answers respectively. By assuming that abductive explanations contain only concept/role assertions and all assertions over the same concept/role name have the same positive weights, the two distances are respectively $\mathsf{weight}(\mathsf{Conference}(\mathsf{JETS}))$ and $\mathsf{weight}(\mathsf{pubYear}(\mathsf{Semantic\_ELearning}, 2004))$. If venues are more important than years when ranking papers for the given CQ, namely $\mathsf{weight}(\mathsf{pubYear}(\mathsf{Semantic\_ELearning}, 2004)) < \mathsf{weight}(\mathsf{Conference}(\mathsf{JETS}))$, Semantic_ELearning will have a higher rank than The_Educational_Semantic_Web.

Consider again the explanation cases in [11]. Abductive reasoning is suitable for most suggestive cases, esp. for explaining why a learning/instructional process cannot achieve a goal and showing extra resources to achieve the goal.

4 Challenging Problems

Besides some challenges from the perspective of e-learning [6], such as design of e-learning ontologies and privacy protection, other challenges come from the perspective of ontology reasoning. The most challenging problem is scalability. The problem of conjunctive query answering can be treated as a set of query entailment problems and a query entailment problem is up to 2ExpTime-hard for OWL DL without nominals [14]. This result implies that conjunctive query answering does not easily scale to large OWL ontologies. Though there exist OWL reasoners that support conjunctive query answering, such as KAON2 [21] and Pellet [22], they do not work well for large benchmark ontologies [15]. Some techniques are proposed to tackle the scalability problem, such as approximation [23] and decomposition [15]. But they still suffer from the problems of sacrificing completeness [23] and unsuitability for handling ontology changes [23,15]. On the other hand, the problems of justification finding and abductive reasoning are harder than query entailment problems, thus have a poor scalability too. To the best of our knowledge, currently there is only one OWL reasoner, i.e. Pellet [22], supporting justification finding and there is no OWL reasoner supporting abductive reasoning. Pellet seems infeasible to find all justifications in large OWL ontologies. Though ontology modularization techniques [24] make such situation better, the improvement is still limited.

5 Concluding Remarks

This paper studies how to exploit the established ontology reasoning techniques coming with OWL, including conjunctive query answering, justification finding and abductive reasoning, to support e-learning. Case studies demonstrate the usefulness of these techniques in providing better e-learning facilities. Future work includes developing scalable algorithms to make these techniques more practical and integrating these techniques in e-learning systems.

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Application of Handheld-Based Science Inquiry Experiment—Exploration of the Reaction Condition of Ferric Chloride Hydrolytic Action

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Abstract. Hand-held technology (graphing calculators, CAS calculators, and data collection devices) is becoming used in science teaching in middle school. In this paper, we select new chemistry course content of compulsory "The main factors that affect ferric chloride hydrolysis" as the inquiry learning theme, explores the "Support role" effect of the handheld technology in students' learning".

Keywords: Handheld technology, Science Inquiry, exploration.

1 Introduction

China introduced handheld technology(graphing calculators, CAS calculators, and data collection devices) to the middle school teaching is in the last century, and Most studies on Handheld technology focused on mathematics, physics and chemistry teaching areas. In the field of chemistry education, more and more research focused on the application of handheld technology in chemical inquiry learning. The concept of chemistry equilibrium and Le Chatelier principle is the important and basic principle in the chemical knowledge in high schools, which has been a hot research focus at home and abroad. We select " The factors affecting the hydrolysis of salts" as the inquiry learning theme, which selected from new chemistry course content of compulsory, Combination of constructivism theory , explores the "Support role" effect of the hand-held technology in students' learning" The main factors that affect ferric chloride hydrolysis".

2 Paper Content

Based on The main factors that affect ferric chloride hydrolysis as the experiment and research content vector, this study tries to find out reasonable teaching strategies in Science Inquiry in the situation of using hand-held technology with the new

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instructional technology named “handheld technology” in the teaching and experiment activities.

Students have learned “chemistry equilibrium”, “Weak electrolyte”, “Le Chatelier principle” and the concept of “Salt hydrolysis”, and they have explored “Acid-base titration” using the handheld technology. All of the learning activities according to the Inquiry-based learning process, which mainly constituted by “Question- Hypothesis - Experiment design- Experiment- conclusion”.

2.1 Question

What are the Influence factors of ferric chloride hydrolysis?

2.2 Hypothesis

According to the experience and the reference, Students put forward their hypothesis that the Influence factors of ferric chloride hydrolysis may include three aspects:

1) The solution concentration
2) The solution temperature
3) catalyst

2.3 Experimental Design

First, students set up 7 groups under the teacher. Then each group choose an experimental to explore. After the discussion, each group should draw an experimental design(including the selecting of sensors, the data that needs to collect, etc), enumerate a list of experimental reagent and instrument. Teachers should prepare various resources for students may need to use, such as Experimental reagent, Experimental instrument, reference and Network resources etc.

Table 1. Experimental design of external conditions and explore content of the main factors that affect ferric chloride hydrolysis

External conditions	Explore content
Add a little FeCl3 solid	Increased concentration of reactants
Add a little distilled water	Solution concentration on the reaction rate
Add a little hydrochloric acid solution or Sulfuric acid solution	Increased concentration of products
Add a little sodium hydroxide solution	Decreased concentration of products
Add 3 drops of KSCN solution	Decreased concentration of Fe3+
Elevated temperature	Explore the influence of temperature on the reaction rate
Add a little NaCl solid	the influence of The Cl- concentration on the reaction rate

2.4 Experimental Results

Each group to finish an inquiry experiment, recorded the Experimental results. Students can use the handheld technology to finish the Inquiry experiment. Finally, Students explain the change of the interpretation tendency and the curve shape combining their existing experience.

Table 2. The influence on ferric chloride hydrolysis and the explaination of the main factors that affect ferric chloride hydrolysis

External conditions	The influence on ferric chloride hydrolysis and the explaination
Add a little FeCl3 solid	Concentration of reactants increase, Chemical reaction equilibrium Move to the right, Promote hydrolysis
Add a little distilled water	Promote hydrolysis
Add a little hydrochloric acid solution or Sulfuric acid solution	Increased concentration of products, Restrain hydrolysis
Add a little sodium hydroxide solution	Hydrogen ion concentration decreased, Chemical reaction equilibrium Move to the right, Promote hydrolysis
Add 3 drops of KSCN solution	produce Stability of complex, Fe3+ concentration decreased, Chemical reaction equilibrium Move to the left, Restrain hydrolysis
Elevated temperature	Hydrolysis reactions is endothermic reaction, Promote hydrolysis
Add a little NaCl solid	Changes of the Cl- Concentration didn't influence the Hydrolysis equilibrium

3 Conclusion

Through the experiments, each group can draw a conclusion. Then they communicate with others. Finally, they can summarize the Influence factors of ferric chloride hydrolysis by themselves. Teachers encourage students review and evaluate their performance during the inquiry activities.

In this chemistry inquiry case, handheld technology enable learners constantly adjust inquiry plan until problem solved because it can collect data and generate experiment images automatically and quickly. So, it helps learners continuously improve their meta-cognition level and the ability to solving problems in the inquiry process.

Handheld technology can not only help learners participate more in higher cognitive activities, such as thinking, analysis, discussing and introspection, but also can stimulate learners' cognitive conflict as a powerful tool of cognition. It can help learners constantly perfect the scientific concept of chemistry through accurately distinguish wrong conception and similar conception. However, whether handheld technology could be used widely in the future in our nation constrained by many subjective factors(teacher's attitude, students' attitude, teachers' information literacy and ability, etc) and objective factors(class hour, evaluation system of college entrance examination,etc). In addition, How to play advantage of handheld technology under the background of the new curriculum in chemistry is also a question which needs our chemistry teachers thinking constantly.

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Construction Situations Promote the Self-learning of Data Structure

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Abstract. This paper discusses the model of training professional man for computer under popular high education combined experiment learning of data structure. Our school takes an active part in some computer competition which shows that it is necessary to reform our experiment learning and promote the self-leaning about data structure.

Keywords: experiment learning, competition, radix sort, minimum cost spanning tree, hash function.

1 Introduction

In recent years, with the constant expansion of the higher education of our country, it has entered the popular stage of development and appeared the diversification characteristics of the social demand for computer professionals. Therefore, the Teaching Guidance Committee about the Computer Science and Technology Ministry of the Higher Education Ministry has developed professional standards about "three types, four directions", which the direction of computer engineering is one of project-based training model. According to the professional standard, how to cultivate high quality talents of computer professionals under the popularization of the higher education in China is a major issue for our computer education. Combined with the Data Structure course, this paper mainly discusses the professional competition for computer engineering training.

Over the past five years, our "student-centered, focusing on the student's comprehensive ability" as the teaching ideas, we helped students to master the basic theories and methods of computer program. In order to take full advantage of the limited teaching time and organize the classroom experiment teaching, the completion of teaching objectives, it was introduced that the application background of driven learning strategies and methods in the experimental teaching about our courses, which was to explore and practice the "data structure" application context-driven practice of teaching methods' reform. Mainly include:

(1) the Hierarchical Approach: according to the student 's ability, we give full play to the different levels of students and carry out experimental tasks step by step.

(2) to Create Learning Situation: we will put the new knowledge into the practical application and promote the learner's internal and external knowledge.

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(3) to Improve Students Theoretical and Practical Skills: we will organize some of the excellent students to take participate in some competitions such as National Computer Simulation, ACM programming Competitions and so on, which our students has receiver very good results.

2 Practice Learning of Data Structure

"Data Structure" course is the theoretical foundation of computer science algorithms and software engineer techniques, which mainly studies the logical structure of information and its basic operation about representation and implementation in the computer. The learning of this course is the process of complex programming training course. Students are required to write the program structure clear, correct and legible, consistent with the norms of software engineering.

Practice Learning makes the students to learn how to combine book knowledge to solve practical problems and develop the programming ability, which the software engineer is needed. At the same time, Practice Learning can also life the book knowledge and further deepen the understanding and flexible teaching. In order to cultivate students' innovative consciousness and improve the practical ability, we can train students to analyze specific issues, build mathematical model and solve the actual problems ability through the experiments of Data Structure.

There have many algorithms in data structures course, therefore, out students cannot achieve all the experiments in the limited time. So, we extracted the eight experiments from data structure course and require all students must be completed in the experimental class because we think these experiments are the base layer or the basic experiments. In order to further develop students to analyze and solve the practical problems ability, we also design some situations for the application of the knowledge. Finally, some students are selected to take participate in the professional competition, which can arouse the students' innovative thinking.

Therefore, in the practice of data structure teaching, we take the following steps mainly:

The first step: ask students to master the basic algorithm and its implementation;

The second step: give students corresponding situation of experiment and require them to analyze problems, that is, “modeling - design algorithm - choose storage structure of the selection algorithm”

The third step: Performance Analysis - algorithm simulation - optimization model

The fourth step: programming and debugging the problem.

Table 1. An Information System

	a	b	c
x1	1	1	1
x2	2	2	2
x3	1	1	1
x4	2	3	2
x5	2	2	2

For example, the radix sort algorithm is applied to data classification. In rough set theory, the object classification is achieved by the indiscernibility relation.

In table 1, U/IND(a)={{x1,x3},{x2,x4,x5}}.

You can get U/IND(a,b,c) as follows according the radix sort algorithm:

The first distribution result:

Front[1]->x1->x3<-End[1]

Front[2]->x2->x4->x5<-End[2]

The first collection result:

x1(111)-->x3(111)-->x2(222)-->x4(232)-->x5(222)

The second distribution result:

Front[1]->x1->x3<-End[1]

Front[2]->x2->x5<-End[2]

Front[3]->x4<-End[3]

The second collection result:

x1(111)-->x3(111)-->x2(222)-->x5(222)-->x4(232)

The third distribution result:

Front[1]->x1->x3<-End[1]

Front[2]->x2->x5->x4<-End[2]

The third collection result:

x1(111)-->x3(111)-->x2(222)-->x5(222)-->x4(232)

The results of data classification are as follows:

{ x1 , x3 },{ x2 , x5 },{ x4 }

Fig. 1. Data classification by radix sort

3 Case Study of Professional Competition

In recent years, we have organized some of the best students to take participated in the two National Computer Simulation Grand Prix, which have all received good results. In 2004, the first National Computer Simulation Grand Prix, we used hash function method, a computer simulation method was successfully used to solve a dollar higher equations and received the national second place in the first competition. The results

can see the papers [2,3]. In 2006, the second National Computer Simulation Grand Prix, we used the optimization problem of graph structure to solute the resonance point of the control theory. The recommendation retrieval intelligent system of sports tickers won a second national prize. The results see [4].

Following is a brief knowledge of the data structure under the situation point.

3.1 The Situation of Hash Function

The following is our works in the first National Computer Simulation Grand Prix (Coach: Cheng Yusheng). The problem is described as follows:

Give a higher n-polynomial equations as follows[2,3]:

$$k_1 x_1^{p_1} + k_2 x_2^{p_2} + \cdots + k_n x_n^{p_n} = 0$$

x_1, x_2, …, x_n is unknown number respectively, k_1, k_2, …, k_n is coefficient respectively, p_1, p_2, …, p_n is exponential number respectively and their value is great than zero, the number of equations are all integers. Assumptions unknown number x_i and its range is $1 \leq x_i \leq M(i=1,2,\ldots\ldots n)$, the question is how to get the numbers of integer solutions about this n-polynomial equations(Notes: the numbers of integer solutions are less than 2^{31}). Among them, the constraint conditions are as follows:

$$1 \leq n \leq 6; 1 \leq M \leq 150;$$
$$|k_1 M^{p_1}| + |k_2 M^{p_2}| + \cdots + |k_n M^{p_n}| < 2^{31}$$

From the equation of the known conditions, it has 6 unknown numbers, and the range of each unknown x_i is up to M. If an algorithm of using simple enumeration method to solve the above question, then its time complexity is $\mathbf{O(M^6)}$**.** Assuming the unknown number is n, and its value does not great than M, the function of F(n) stands for the largest solution methods by the binary method. So the time complexity of the problem is mainly concentrated in the use of hash technology to store all possible values of left expression A into the array $M^{F(n)}$, corresponding to the time complexity is $O(M^{F(n)})$. While the all values of in right expression B using hash method, the time complexity is $O(M^{F(n)})$ also. Therefore, the total time complexity T(n) is $O(M^{F(n)}) + O(M^{F(n)}) = 2 \times O(M^{F(n)})$.

Consider the A expression: the possible values of $k_1 x_1^{p_1} + k_2 x_2^{p_2} + \cdots + k_n x_t^{p_t}$ and store all the value of A by using hash technology, there has 150^3=3375000 different values in the worst case. So the length of hash table can be defined as 3375000. And taking into account the same value may appear several times, so the storage structure is defined as two domains: S field stores value of expression and Count field stores the occurrences of the same values. The storage structure is defined as follows:

```
Type Sqlist
    S_data As Double
    Count As Double
End Type
```

The hash function is selected as follows: h(k) = k mod p, among them p=3375000. In order to solve the conflict, we use re-hashing technology. The re-hashing function is defined as follows: (h(k)+i) mod p, i=1,2,3……

Example 1. n=4,M=150 k1=k2=-1,k3=k4=1,pi=2(i=1,2,3),p4=3, the simulation result is 5167, see Fig 2.

Fig. 2. Test data

3.2 The Situation of Shortest Path Algorithm

Our works (Coach: Cheng Shulin) of the second National Computer Simulation Grand is described as follows:

In order to connect the seven cities of a province, a communication network system is needed to be built the minimal cost according to each of the distance between two cities. Considering the influence of the geographical environment, the distance and the costs per kilometer, how to build the minimal cost network?

The total routes are 7*6/2=21 because for any city, there has 7-1=6 lines, which can be communicated with each other. The question is that 6 routes are selected from in the 21 lines, which can be communicated with each other in 7 cities and the cost is the minimal. Now this question will be converted into the corresponding undirected complete graph of the minimum spanning tree problem. In addition, many fuzzy words are given such as COMPLETELY, ALMOST, VERY COLSE, COLSE, LESS CLOSE and so on. But the exact values of these vague terms are not determined exactly. So, we try to take the following methods:

The first step: the fuzzy words are specified a broad range, such as (0.8-1);

The second step: the user can input a specific value for each ambiguous word according to their own understanding of the strength or actual needs.

The third step: in the range of each fuzzy word, select a corresponding value.

The fourth step: Based on the above the input parameters, the edge weights can be calculated, which stands for the cost of a route between the two cities, that is, the cost equal length*fuzzy quantitative value.

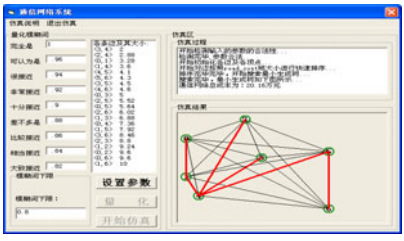

Fig. 3. The Problems of Path Optimization

3.3 The Situation of Circular Queue

The quality and efficiency of elevator group service by computer simulation is given as follows (the first prize of the National Computer Simulation, 2009, Instructor: Huang Zhong):

An office building has 20 layers with five passenger elevators. Using Visual C++ programming and OpenGL visualization technology, we simulate the scheduling of elevator group in the high building, while the operating performance of each elevator and elevator service quality for passengers are analyzed. In order to achieve the elevator service quality and simulation of passenger activity, its simulation in two ways: (1) manual control; (2) automatic control mode.

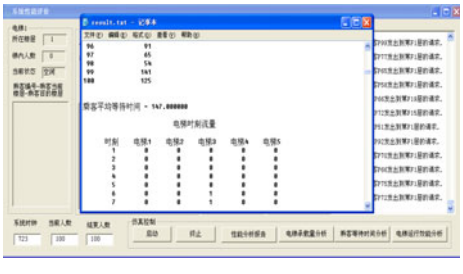

Fig. 4. Simulation for Elevator

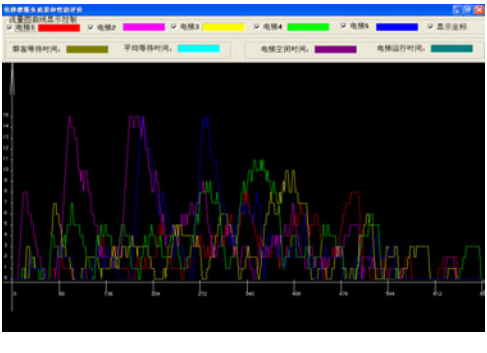

Fig. 5. Performance analysis for elevator scheduling by Circular Queue

4 Conclusions

2004 is the first national computer simulation competition, because it is the first time to participate in the national contest, we selected the most outstanding students, through 15 days of hard work, and we achieved excellent result. In 2006, each team arranged a teacher for guidance. At the same time, we invite some excellent teachers to train students before the competition. In the teacher's careful guidance, the final works by Cheng Yusheng won the two prize after 15 days.

Through computer simulation competitions, not only taught students research ability, cultivate students' team spirit, it is more important to develop students' creative thinking and practical ability. The above results and our institute in recent years, carried out a series of" requirements of the training of students' practical ability and innovative thinking" activity is inseparable, and it is a big exploration for the computer engineering talents cultivation in the background of popularization of higher education.

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Teaching Reform in Java-Based Programming Curricular System

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Abstract. For the current existence program that programming curricular system is complex but not clear, a programming curricular system, using Java as the core, is proposed in the paper. The teaching objectives, theory and practice of teaching system based on Java in the curricular system is analyzed. According to this curricular system, a teaching reform is established to develop market-oriented training program, teaching method and improve the teaching evaluation system.

Keywords: Java, programming curricular, teaching reform, teaching method.

1 Introduction

At present, major colleges and universities in china are now offering a series of programming courses and have formed a set of curriculum, in which includes: procedure-oriented structured programming courses such as C and Pascal , object –oriented programming courses such as C++, Java and C #, and application-oriented programming courses such as Delphi, Visual Basic, Visual C++, JSP, ASP.net. By learning these coursed, the aim is to help students build programming ideas, improve programming skills and analytical ability to solve practical problems.

However, through making an investigation for the product of higher education, the graduation design and employment, it is found that students master the basic knowledge of prevalence is not strong, less of operation, and not very-seen for a programming language. Therefore, if students, in their four year collage life, only master a specified programming language and use it to learn data structure, object-oriented programming design, network programming, database, Web programming and so on, this will not only make the students concentrate on breaking the language barrier, but also addresses students program specifically designed for broad but not shallow and not deep problems, and will help students develop themselves later.

2 Java-Based Programming Curricular System

Java since 1995, officially launched by the Sun, quickly becomes the world's mainstream programming language, and its cross-platform advantages of network computing technology has brought revolutionary changes, and Java is also a shift from a programming

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language to the world's leading development platform. Java as a programming language, has the following advantages.

- Java is easy to learn. The basic grammar rule in Java is similar to C, and complex pointer in C, and C + +, memory management in C++ are difficult to learn and are removed from Java, which will help beginners to understand and grasp Java.
- Java is a fully object-oriented programming language. As an object-oriented programming language, Java is not only the most "pure", while its support for object-oriented approach and most comprehensive.
- Java supports network programming. Java's JDK provides a rich library of network, such as the Socket API, Java Mail API, which greatly simplify the development process of network programming.
- Java supports for database programming. The JDK provides the Java JDBC API which simplify the code to access the database, and JDBC-based database system does not rely on database management systems.
- Java supports Web programming. To support Web programming, Sun introduces the Servlet, JSP and JSF technologies, and many other third-party companies also offer Java Web programming frameworks such as Struts, Spring and Tapestry and so on.

Thus, we can use Java as the core of language in programming curricular system, and intersperse it into the object-oriented programming design, network programming, database theory and design, Java advanced programming, dynamic web development, Java EE enterprise architecture and development and so on, to improve students' programming ideas and operation ability.

A Teaching Objectives

The ultimate goal of Java-based programming curricular system is to understanding, programming and application. Understanding means to enable students to understand the basic grammar rules and Java programming specifications, the basic concepts and basic ideas of object-oriented. Programming means to learn to master the object-oriented programming, GUI programming, network programming, database programming. Application means to enable students to be able to apply Java technology to enterprise information systems development.

Programming curricular system for the purpose of teaching and research is to use Java as an introductory object-oriented programming language, basic application and development platform, and combines other programming courses, as shown in Figure 1 Construction of multi-level, three-dimensional courses system to Java to the core, throughout the course system, step by step, the organic integration, consolidation of deepening students programming skills to ensure the sustainability of development.

Java EE Enterprise Architecture and Development(64 hours)		Course Design of Java EE Enterprise Development (2 weeks)
Dynamic Web Development (72 hours)	Network Programming (32 hours)	Course Design of Java Advanced(2 weeks)
Java Programming (32 hours)	Database Theory and Application (56 hours)	Course Design of Java Programming(2 weeks)
Data Structure (72 hours)		Course Design of Data Structure (2 weeks)
Object-oriented Programming (56 hours)		Course Design of Object-oriented Programming (2 weeks)

Fig. 1. Java-based programming Curricular System

B Teaching Theory

In figure 1, the theory of teaching curriculum system involve many courses, and those courses are continuous with each other and are closely related to Java, so we develop the theory of principle " for Java, stressed the continuity and relevance to address the key Overcoming Difficulties" . Taking into account that the freshmen are very limited and poor in the basics of computers and programming. We open a computer introduction course in the first semester, which mainly teaches basic computer operation and the C language, and its purpose is to enable students to master basic computer operations and train students for program design process. On this basis, from the second semester of the beginning of the course object-oriented programming Java programming based on the teaching of courses has been extended to the sixth semester of the Java EE architecture and development of enterprise-class courses. .Net programming is different from the system as a programming course in seven semester, and it is a useful supplement to the curriculum system and extend and enrich the programming courses.

Object-oriented programming course focuses on teaching basic Java language syntax, arrays, object-oriented programming (encapsulation, inheritance and polymorphism), I/O technology, and need to break through the difficulty in object-oriented programming, variables, and object storage model, I/O model. Data structure course focuses on teaching the logical data structure, storage structure and corresponding algorithms, algorithm analysis of space and time; and need to break the focus stack and queues, arrays, and generalized form, trees and graphs, sorting and other applications.

Taking into account that the second and third term is mainly making a good foundation, therefore, a programming course is arranged in each semester. The fourth and fifth semester open two programming courses. Java programming, database theory and application are open in fourth semester. In which, Java programming is the extension of object-oriented programming and data structure courses. Java programming course mainly teaches collections and generic, multi-threading, GUI programming, JDBC technology. Database theory and application mainly teaches relations between the major teaching algebra and relational calculus, SQL statements, database design. Because Java programming course mentions JDBC, which requires students to have some database knowledge, therefore, database theory and application should be open before Java programming. We open two courses in same semester, so

Java programming should be open in the latter half semester which not only helps students to grasp and understand JDBC technology, but also helps the students to master knowledge of database application. Dynamic web development and web programming are open in the fifth semester. Among them, dynamic web development mainly teaches HTML, JavaScript, JSP and other dynamic web development technologies. Network programming primarily teaches socket-based block and non-block communication in the TCP and UDP, as well as some application layer protocols. Taking into account that the principle of dynamic websites related to HTTP protocol, network programming should be open 3-4 weeks early before dynamic web programming. The last course of the curricular system is Java EE enterprise architecture and development ,which mainly teaches third-party framework based on Java Web programming primarily, such as SSH (Struts, Spring and Hibernate for short). Those third-party framework will help students to master development methods and techniques of the latest enterprise information system.

C Practice Teaching System

The practice of the teaching curriculum is divided into two elements: curricular experiment, course design. Each course is accompanied by a certain hours of curricular experiments, by which allows students to design programming and complete a single programming and test in order to master corresponding knowledge unit.

Course design synchronize with a course is configured in each semester. Through developing a simple integrated system, it will help to enhance students' analyze, design and programming capacity and make them have an initial capacity of system development. Object-oriented course design is designed for Object-oriented course , and data structure course design is designed for data structure. Java programming course design is designed for Java programming course and database theory and application course, and therefore, the course design can be divided into two parts: Java graphical game programming and Java database programming. Java advanced programming course design is designed for dynamic Web development and network programming course, and therefore, the course design is also divided into two parts: the part of network programming and dynamic web development. Java enterprise development course design is designed for enterprise Java architecture and development. Through the arrangement of specific topics, students are required to use Struts, Hibernate and Spring to integrated develop.

The topics and requirements of course design are published in the beginning of the semester. Choosing topics and grouping is completed two weeks before the beginning of course design. Subject of course design should have a certain practicality, feasibility, moderate difficulty and design work, and allow the students to set problem by themselves.

3 Teaching Reform in Java-Based Programming Curricular System

A Customizing Training Plan According to Market Requirement

Computer software technology is constantly updated and developed, so we design syllabus, teaching schedule and examination plan of the curriculum system based on

Sun's SCJP (Sun Certified Java Developer) and SCJD (Sun Certified Java Developer) in order to adapt students to the command of market. We should make sure that SCJD SCJP certification knowledge point is perfectly and compact arranged in the various courses, lectures ,and ensure that the content of course is close to development pace of mainstream industry and technology.

B Optimization of Teaching Methods

To learn programming better, strong logical thinking ability and a more solid mathematical foundation is need. But some students are relatively weak mathematical foundation, which is bound to greatly reduce their interest in learning programming courses. In addition, the traditional teaching take mode care in examination and less care in practice, and the core of teaching content is how to get a more grade, so student is forced to learn, lack of practical ability and innovative ability to play. To this end, we propose the following reform of teaching methods.

- The introduction of pair programming. Two programmers is common to use a computer monitor and keyboard to control the keyboard and mouse, and write down design, code and test cases together. In the curriculum system, course design are used in pairs to complete the programming mode, such as in the part of Java advanced programming courses design, two students analysis, design and code client and server-side program together, during which they can learn from each other and transfer experience to provide better design and better code, not only tempered the more problem solving, but also cultivate a team spirit and get more satisfaction.
- Using heuristics and discuss teaching. Heuristic and discuss teaching stimulate student interest in learning, enhance learning initiative, enthusiasm and creativity through the fruit after result, analysis questions, interactive programming, program debugging, discuss together etc.
- Implementation of case teaching. Case-driven instruction required students to think and discussing with the task needed to be solved. The introduction of appropriate, fun case in classroom, such as the introduction of Snake game in Java programming course, video and sound chat game in network programming, to mobilize the enthusiasm of the students. In the process, the elaboration and application of basic concepts of operations to start around the case from beginning to end throughout the whole teaching process.

C Improve the Teaching Evaluation System

In order to better evaluate the overall quality of teaching curriculum and teaching effectiveness, the teaching evaluation system should be established

- Evaluation system on teachers. Establishing an objective, fair and scientific evaluation index system and method of calculation to evaluate process and attitude of teaching, method and effective of teaching.
- Evaluation system on students. Teachers evaluate students' assignment, discussion, self-learning ability and ability to apply knowledge to solve problems, and give feedback to students in order to urge students to improve.

4 Conclusion

Training is an important social mission given to colleges and universities, and the mission of colleges and universities is to delivery high quality students for the enterprise. By establishing Java-based programming curricular system, customizing training plan to meet market demand, optimizing the teaching methods and improving the teaching evaluation, a new programming curricular system is realized. The curricular system implements innovative teaching program and has a very important guiding significance to ensure the quality of software personnel training.

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On Security System: Study Based on Transaction Chain*

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Abstract. Based on the division of transaction chain, we analyzed different security systems in different links by introducing reputation system and appeal system to the basic game model. It is proved that both reputation system and appeal system is able to lead the game to cooperative equilibrium. When both of them are in role, it allows a wider scope and is able to relax restrictions on assumptions that enable model works in each single system. Therefore, the two security systems on the transaction chain can complement each other and provide guarantees for online transactions together.

Keywords: transaction chain, reputation system, appeal system, cooperative equilibrium.

1 Introduction

The theory of consumer behavior divides consumers' shopping process to three parts: ex ante transaction, in-transaction and ex post transaction. Ex ante transaction includes information retrieval, comparison, transaction communication, and negotiation; in-transaction means the behavior of dealing via signing a contract; ex post transaction includes payment, delivery and after-sale service. Ratnasingam (1999) divided the process into three phases: pre-transaction, transaction and post-transaction phase. Pre-transaction means advertisement and communication; signing a contract, paying and delivery are in the transaction phase; the post-transaction phase mainly refers to after-sale service, including quality assurance and refund acceptance. Atif (2004) considered the e-commerce transaction a three-stage process: the first stage is about searching and communicating; the second stage means building the path of trust, signing a contract; the final stage includes carrying out the transaction (payment and delivery) and after-sale service. Therefore, dividing the trading process into three phases is acceptable for most scholars. Following this division, we classified different steps into these three phases. We think that the ex ante transaction refers to information retrieval, comparison, and communication and negotiation about transaction. The in-transaction phase means virtual action of trading between the two

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sides. The ex post transaction includes after-sale service; for the online transaction with credit evaluation system, the evaluation of the deal is also included. Both the two security systems are able to protect consumers in online transaction from sellers' opportunistic behavior.

2 Reputation System

We construct a simple game model here. There is a consumer and a seller in the market. The consumer has to decide whether to trade with the seller. If the answer is *yes*, the game will move forward to the seller's decision-making stage.

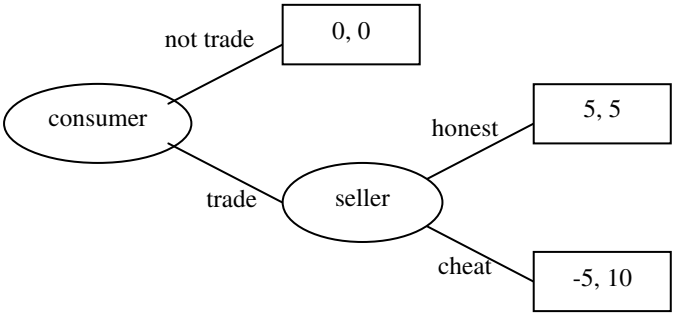

Fig. 1. Game tree: basic model

As is shown in Fig.1, the Nash Equilibrium is that consumer chooses not to trade and seller chooses to cheat. This is a very disappointed outcome. If the two sides choose to cooperate, the social surplus will be 10, which is better than the outcome of not cooperating. The consumer will not trust the seller because of its opportunistic behavior, and then cooperation does not occur.

A way to solve this is to sign a contract before transaction, which specifies that if the seller cheats, it must compensate the consumer, let's say, 6 units. If the contract is complete and the action of cheating can be proved in the court, the seller will get 5 when being honest and 4 when cheating. Therefore, if consumer expects this complete contract will be enforced, it will trust the seller and thus, we get the cooperative equilibrium. However, in the real world, this kind of contract may not be feasible, so the optimal choice for the consumer is still not to trade with the seller. The cooperation still does not appear. Zhang (2002) solved this dilemma by introducing long-term game. If there is an opportunity for the two sides to game repeatedly, they can finally achieve cooperation. The repeated game creates reputation system, that is, the accumulation of previous trading records will give a signal for next trade.

Assume that the two sides are in infinite game, the discount rate is δ, and every game is of the same structure. The consumer is considered to follow the trigger strategy: I trust you at first; if you are honest, I will continue to trust you; but if you cheat me, I will never trust you again. Now the seller needs to compare the instant gain from cheating and all the future income from being honest. If it chooses to cheat,

it will get 10 in current period, but 0 in the future, the total income is 10. If it chooses to be honest [1], it will have the income of 5 in this period and all the periods afterwards, the total income is $5+5\delta+5\delta^2+5\delta^3+\cdots=5/1-\delta$. Only when $5/1-\delta$ is greater than the income from cheating, will the seller's optimal choice be to be honest. Thus, when $\delta \geq 1/2$, the opportunistic behavior of seller will not occur, and then its optimal strategy is to be honest. The key for reputation system is that for the long-term cooperation benefits, the party concerned is willing to resist the instant profit brought by cheat once. Therefore, as long as the seller's cheating behavior can be observed by the consumer, the seller is still willing to build good reputation.

3 Appeal System

Now we consider another condition by extending basic model with consumer appeal system. When the consumer is aware of seller's cheating, it can choose to appeal with a appeal cost. When making decision, the consumer will compare the appeal cost and potential compensation. The game is altered to the shape shown in Fig. 2.

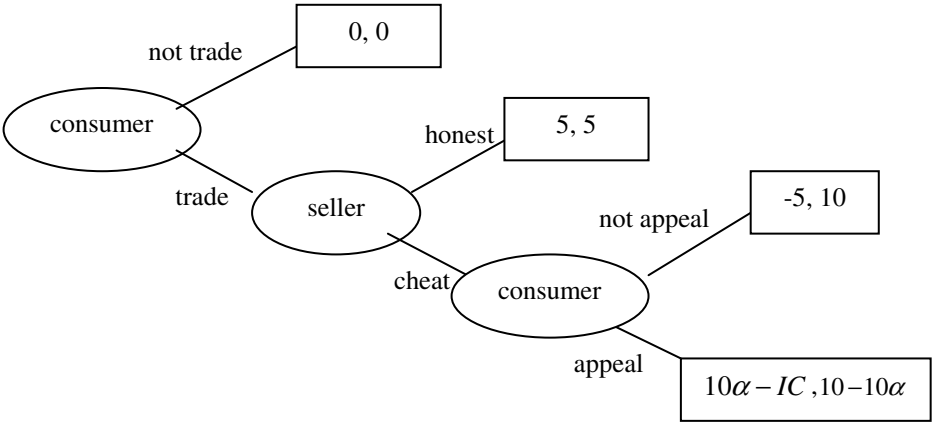

Fig. 2. Game tree: extended model

In the model, it is assumed that the cardinal number of compensation is fixed. α measures the probability for the consumer to get the compensation when appealing, it can be considered as the a measurement of sophistication of legal system in the market. From another point of view, α describes the extent to which the consumer will to try. Therefore, 10α means the expected compensation and $\alpha \in [0,1]$; IC (implementation cost) is the cost on appeal for consumer. It is a

[1] The results of choosing to cheat at period t and period t+n are the same, since the game is infinite, seller's decision of whether to cheat has nothing to do with the current number of period.

function on α, and $\partial IC(\alpha)/\partial\alpha > 0$. The implementation cost rises with the efforts from consumer.

Assume that the trade is one-time, and we find the Nash equilibrium by backward reasoning. Given that the consumer choose to trade and the seller choose to cheat in the early stages of game, if consumer chooses to appeal, it will get the income of $10\alpha - IC$; but if it gives up appeal, it will lose 5 units. Therefore, for consumer, only when $10\alpha - IC(\alpha) > -5$ will it choose to appeal. As qualitative analysis here, to simplify the analysis and calculation, we assume that $IC = 8\alpha + 6$. Now the outcome of (trade, cheat, appeal) is $(2\alpha - 6, 10 - 10\alpha)$. Then we get the condition for consumer to appeal: $\alpha \geq 1/2$. When the probability of getting compensation after appealing is greater than 1/2, the optimal choice for the consumer is to appeal. Now, we further consider the seller's behavior. Assume that α and $IC(\alpha)$ are common knowledge in the game, so the seller will take the consumer's optimal choice into consideration when making decision. If $\alpha \geq 1/2$, then $10 - 10\alpha$ and the optimal choice for the seller is to be honest. If $\alpha \leq 1/2$, the seller knows that the consumer will not appeal at the last stage, so it will choose to cheat, and then the optimal choice for the consumer in the first stage is not to trade.

Therefore, the Nash equilibrium of this game is (trade, honest, appeal) when $\alpha \geq 1/2$ and (not trade, cheat, not appeal) when $\alpha \leq 1/2$. This accords with people's common sense that when the external legal environment is favorable and the legal system is sound, even if the contract is incomplete, consumer's appeal is still easy to get legal support and compensation. Moreover, the seller, as an opportunist, will not choose to cheat easily. But when the external legal environment is not so favorable, the implementation cost to appeal will be very high. Facing potential cheating, the consumer has to choose not to trade in the first stage of game. In sum, in the circumstance of sound legal system, the game will bear a win-win result by introducing appeal system.

4 Combination of Two Systems

What will happen if we introduce implementation cost of appeal and compensation into long-term game? To specify this issue, we modify initial assumptions of the basic model. Now assume that there are n sellers and n consumers in the market. Seller's behavior of cheating can always be observed by some consumers, the difference lies on the number of such consumers. Assume that if the victim's appeal successes, all consumers in the market will know such an event and according to trigger strategy, they will not trade with the cheater any more; if the victim's appeal fails, only a part of consumers, let's say k, will know this behavior of cheating and not trade with the cheater. In the latter case, the probability of choosing by consumers for the cheater will reduce by $n/n - (n-k)/n = k/n$. k measures the scope of online information propagation. To simplify analysis, we assume $k = (1-\alpha)n$. This assumption is consistent with the fact, since not all consumers will concern about seller's previous

transaction record; but if seller cheats and consumer successes to appeal, the influence will be large enough to have effects on consumers' purchasing decisions.

The results of game will change because of different scope of propagation. Here, the object of analysis is the non-cooperative equilibrium (not trade, cheat, not appeal), which is the result when $\alpha \le 1/2$. We need to inspect whether appeal system and reputation system have effect together and which kind of effect that is. Therefore, here we only concerns consumer's decision when seller chooses to cheat.

From Section 2, we know that in long-term game the outcome for seller to cheat is $5/1-\delta$. When cheating occurs, the probability of a successful appeal is α, which means the cheater's behavior will be observed by all the consumers with a probability of α, and by a part of consumers with the probability of $1-\alpha$. Thus, the outcomes of cheating for the seller are shown in the following table:

Table 1.

	Current period	Periods afterwards
Successful appeal (Pro= α)	$10-10\alpha$	0
Failed appeal (Pro= $1-\alpha$)	10	P

Among them, $P = \frac{(1-\alpha)n}{n} * \frac{5}{1-\delta}$, the first polynomial measures the decrease in probability for the cheater selected by consumers any more; the second one is the sum of income when the seller choose to be honest in each period afterward. Thus, we get the expected total income of the seller after the *cheat* period[2], $\alpha(10-10\alpha)+(1-\alpha)[10+P]$. Then the condition for the seller to choose to be honest for long-term profit is:

$$\alpha(10-10\alpha)+(1-\alpha)[10+P] \ge 5/1-\delta \tag{1}$$

The result of the equation above is $\frac{2\delta-1}{1-\delta}\alpha^2 - \frac{2}{1-\delta}\alpha + 2 \ge 0$. In the reputation model in Section 2, the short-term income brought by cheating and the long-term income brought by being honest are of the same amount when $\delta = 1/2$. In the above equation, $\alpha \le 1/2$ when $\delta = 1/2$. Moreover, $\alpha \le 1/2$ is consistent with the initial assumption of this model [3]. At this moment, as long as α gets its value from its domain, there will be cooperative equilibrium for this game.

Although the appeal system alone may still bring non-cooperative equilibrium, the infinitely repeated game is a good solution to it. It indicates that when the consumer's

[2] Similar as Footnote 1, in view of the infinite periods of game and consumer's trigger strategy, seller's decision on whether to cheat has nothing to do with the current number of period.

[3] We only consider the non-cooperative equilibrium here, and in the model the assumption for it is $\alpha \le 1/2$.

appeal system does not function well, the reputation system will still lead the game to cooperative equilibrium and thus maximize total surplus.

5 Conclusion

Referring to the four necessary conditions for reputation system (Zhang, 2002), we find that two of them are related with appeal: the cheating behavior of the person concerned can be observed in time; the person concerned has enough initiative and probability to punish the cheater. In online transaction, consumer is able to know whether being cheated once it received the goods or service. It is able to decide whether to appeal in a very short time. Because of a certain amount of appeal cost, the consumer needs to balance between the implementation cost and potential compensation. When the external legal system is sound and the legal environment is appropriate, consumer will have enough initiative and possibility to penalize the cheater.

The reputation system works by accumulating and correcting trading records which consumer considers as shopping information. Its effect occurs before and after the transaction. Nevertheless the appeal system works in the phase of trading. The consumer decides whether to appeal after being cheated, when the action of trading has not finished yet. By extending a simple game model with two different items, we reasonably consider that to some extent, the reputation system are also able to complements the appeal system when the external. As two security systems in different links of transaction chain, in spite of different modes and time of action, the two systems can play roles simultaneously and be complementary.

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An Empirical Analysis of the Influencing Factors of Sports Consumption: Based on the Data from 1990 to 2009 in China

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Abstract. This article analyzed the economic factors and cultural factors which influence the residents' sports consumption based on the data from 1990 to 2009 in China. We made both qualitative analysis and quantitative analysis about influencing factors of sports consumption. The results show that, both economic and cultural factors can impact the residents' sports consumption expenditure. In all the influencing factors of sports consumption, income level is the major and most fundamental factor, and sports infrastructure has a positive impact, and working time has a negative impact on sports consumption. Moreover, population age structure will affect consumer attitudes, thus will affect the sports consumption.

Keywords: economic factors, cultural factors, sports consumption.

1 Introduction

Sports Consumption refers to the personal and household consumption expenditure that people take part in sports and enjoy the sight of sports activities. It is an important integral part in the personal consumption spending which can meet the development of consumer and enjoy. It can be divided into two parts, material consumption and the mental consumption: material consumption mainly refers to sports apparel, fitness equipment, sports books and magazines, food and drink and sports-related material consumption, material consumption is the main part in sports consumption of residents in china; the mental consumption spending mainly refers to the expenditures of watching sporting events, performances, exhibitions, sports cultural information and other expenditures.

Health care system reform increases the awareness of physical fitness, while the Government's attention and support provide a guarantee for the fitness industry. China has promulgated and implemented the National Fitness Program which clearly put forward the work of the National Fitness goal: complete Chinese characteristics and national fitness system until 2010, so that the sport can become an integral part people's life. The number of regular physical activity, National Sports and other important health indicators close to the level of moderately developed countries. The Government has viewed national fitness program as part of social welfare, give full support and assistance in funding policy, guidance staff and building, and broadcast

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the role of physical fitness through various media, which will inspire people to participate in sports exercise initiative, and promote the development of the physical fitness industry..

The main structure of this paper is as follows: in Part 2, we will give a qualitative analysis of the influencing factors of sports consumption; the data collection and variables introduction is in Part 3, as well as empirical analysis by OLS; at last, we will draw some conclusions from the empirical results and put forward corresponding policy suggestions.

2 Qualitative Analysis

Sports consumption is a higher level of consumer behavior which through participation in sports or watch sports competitions to use and consume sports resource in order to meet the needs of a variety of sports. Sports consumption needs to have a foundation: First, the material basis, that is the level of social and economic development; Second, cultural foundation, that is the community education process. As China's social and economic development, people's living standard's improve, the improvement and perfection of the market economy, people are becoming more conscious of sports consumption, more and more people want to further improve their quality of life, and gradually realized that the importance of the health and physical exercise, but less leisure time, the traditional concept of culture and consumption, local sports venues, he quantity and poor quality of sports conditions and other reasons t lead the lack of sports spending, but its market potential is huge.

Sports consumption are affected by various factors involved in income levels, cultural factors, educational factors, leisure time, basic sports facilities and many other issues. This paper divided the factors that impact of sports consumption into two parts: inside and outside factors, thus emphasizing sports consumption is the result of both internal and external factors, reflecting the complexity that impact of sports consumption decisions.

2.1 Economic Factors

The amount of sports consumption（C）is positive correlated with the local sports infrastructure（I, personal income level（Income Level, IL） and spare time（ST）. The functional relationship between these variables is,

$$C = F(I, IL, ST) \tag{1}$$

The function has the following properties:

1. Because the sport is a higher level of consumption behavior, when the economic level is very poor, personal free time is very little, and there is almost no infrastructure, the amount of sports consumption will be close to 0, that is, when I, IL, ST value is very small, C approaches 0;
2. When the basis of sports facilities is better, higher levels of personal income, more leisure time, the amount of sports consumption will also increase, that is, the

first derivative F_I、F_{IL}、F_{ST}, are greater than 0, but sports consumption can not unlimited subsequent growth, the growth rate will reach a certain size then slow down as conditions improve, that is the second derivative is less than 0.

2.2 Cultural Factors

Cultural factors are the most far-reaching and one of the most extensive environmental factors on people's sports culture consumer behavior. As a social and cultural phenomenon, Sports has long been integrated into people's lives. Every society has its unique system of consumption habits and ideas, these habits and ideas through family, school and social education, so that members of society, consciously and unconsciously, to accept the social behavior patterns from an early age. The Come apart of School Physical Education and lifelong Sports, can not meet public health needs, which undoubtedly will affect the students' sports-loving habits during and after school, prevent the establishment of lifelong development of sports consciousness, and the concept of sports consumption and behavior will be restricted. This paper consider the amount of sports consumption (Consumption, C), the Chinese traditional culture (Traditional Culture, TC), consumer attitudes (Consumer Attitudes, CA) and education (Education, E), but due to cultural factors can not be quantified, and differences in terms of each individual is also very large, It is difficult to describe the specific function of the relationship between them, the paper will use the age composition of residents of an area to distinguish the cultural differences between different groups, attitudes of different ages of consumer in sports difference is very significant, if culture is a culture that contains a variety of variable factors, the sports consumption function is:

$$C = F(culture) \tag{2}$$

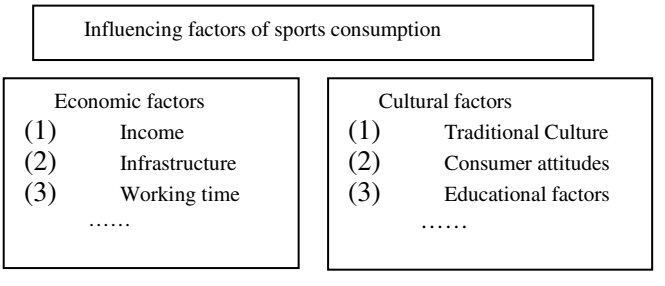

Fig. 1. Scatter plot of the relationship between sports consumption expenditure and Disposable income per capita from 1990 to 2009

3 Empirical Analysis

3.1 Data Collection

The data that we use for empirical analysis is from China Statistical Yearbook 2010 and the web site of Chinese National Bureau of Statistics from 1990 to 2009 in China.

3.2 Variable Definition

According to the analysis earlier in this article, there are many factors influencing sports consumption. Some factors are more easily separated, and relatively easy to quantify, and on the contrary, that some factors (such as cultural influences, consumer attitudes, etc.) is difficult to quantify, In order to facilitate the analysis, also taking into account data collection problems, we selecte the sports consumption expenditure per capita as explained variable; disposable income per capita, basic sports facilities, leisure time and cultural factors as explanatory variables. The name and meaning of the variables are described in Table 1.

Table 1. Variable Definition

Variable name	Meaning
Consumption	Sports consumption expenditure per capita (yuan)
Income	Disposable income per capita (yuan)
Infrastructure	Basic sports facilities
Spare Time	Instead pf Gross Dependency Ratio[1]
Culture	Cultural Factors

3.3 Empirical Analysis

Based on the statistical data available in 1990-2009, the scatter plot of the relationship between sports consumption expenditure and Disposable income per capita is shown in Figure 2.

There is a strong linear relationship between sports consumption expenditure per capita and disposable income per capita. We get the estimation result by OLS (Ordinary Least Square) as follows.

[1] **Gross Dependency Ratio:** also called gross dependency coefficient, refers to the ratio of non-working-age population to the working-age population, express in %. Describing in general the number of non-working-age population that every 100 people at working ages will take care of, this indicator reflects the basic relation between population and economic development from the demographic perspective. The gross dependency ratio is calculated with the following formula:

$$GDR = \frac{P_{0\text{–}14} + P_{65^+}}{P_{15\text{–}64}} \times 100\%$$

Where: GDR is the gross dependency ratio, P0-14 is the population of children aged 0-14, P65+ is the elderly population aged 65 and over, and P15-64 is the working-age population aged 15-64.

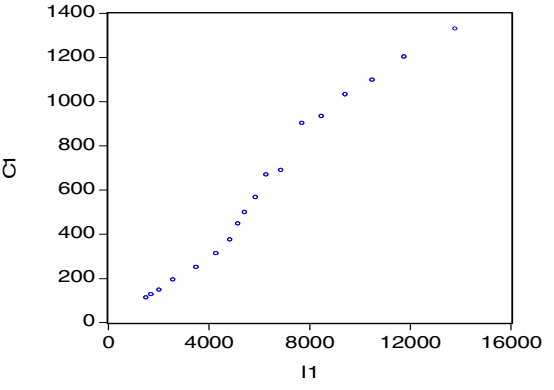

Fig. 2. Scatter plot of the relationship between sports consumption expenditure and Disposable income per capita from 1990 to 2009

Table 2. The Result of Estimation by OLS

Dependent Variable: Consumption Method: Least Squares Date: 06/06/09 Time: 21:43 Sample: 1990 2007 Included observations: 18				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-81.08053	30.89328	-2.624536	0.0184
Income	0.110637	0.004357	25.39421	0.0000
R-squared	0.975789	Mean dependent var		605.1567
Adjusted R-squared	0.974276	S.D. dependent var		396.0230
S.E. of regression	63.51674	Akaike info criterion		11.24492
Sum squared resid	64550.02	Schwarz criterion		11.34385
Log likelihood	-99.20431	F-statistic		644.8658
Durbin-Watson stat	0.637643	Prob(F-statistic)		0.000000

$$Consumption = -81.08053 + 0.110637\,Income$$
$$(-2.624536) \quad (25.39421) \tag{3}$$
$$R^2 = 0.975789, \bar{R}^2 = 0.974276, D.W. = 0.637643$$

4 Conclusions

There are various factors that affect sports consumption, include both economic constraints and cultural factors. According to the results summarized in this article before, we can get the conclusions as follows.

- Income level is a major and most fundamental factor that can affect sports consumption. According to Engel's law, the less a household income, the more proportion of expenditure household income (or total expenditure) used to buy food, as household income increases, food expenditures would decline in the household income (or total expenditure). With the increasing revenue, the expenditure for culture and entertainment (sports) consumer will gradually increase. Physical demand is a kind of needs which people improve health, enhance physical fitness and meet the needs of spiritual and cultural life. It is the demand for a higher level, and people will pursue sports consumption when they meet lower level needs. Therefore, the economic development and the improvement of people's income level will affect and determine the residents' sports consumption.
- The foundational sports facilities have a positive impact on sports consumption. The number of sports venues and facilities per capita in China are very small. Although the venues and facilities around the country have been greatly improved in recent years, especially since hosting the 2008 Beijing Olympic Games, it is still far from adequate. Many sports venues are not open to the public, the high cost of body-building bring people a lot of inconvenience. If these sports venues can become public facilities, the venue management and maintenance, operation and other problems may arise. Now the financial investment of the venue construction and management concentrated in large cities and regions, there is no benefit all, especially in the vast rural areas, there almost no sports facilities, I believe such issues will be gradually improved as the development of economy.
- Too little spare time has a negative impact on sports consumption. If a labor force has to feed a big population and has excessive work pressure, he has no time to engage in sports activities. It restricts the sport consumption. In China, a lot of work is labor-intensive. There is long working hours and very low income. As a result, these people would rarely participate in sports activities. With the financial crisis, the upgrading of industrial structure extremely urgent, labor intensity and long hours of labor-intensive industries will be replaced by high-tech and high added value, it can lead receive the same remuneration in the labor force while leisure time growth, so the sports industry will be actively developed as the third industry.
- Population age structure will affect consumer attitudes, thus will affect the sports consumption. The residents who are between 15 to 64 years old are the main sports consumption population, while they are also working population, their leisure time is limited. If we can spread mass sports, children and the elderly are able to participate in physical fitness activities, and bring the sport as a socialist welfare, and then the negative impact the age structure on the sports consumption will be reduced.

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Research of the Efficiency of High-Tech Industry Based on DEA Model: Evidence from China

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Abstract. High-tech industry of a nation is the determinants of the international competitiveness. This paper analyzed the input-output efficiency of 15 high-tech industries using DEA methodology based on the data of "Basic Statistics on Scientific and Technological Activities Funds of Large and Medium-sized Industrial Enterprises in High-tech Industry (2008)". The empirical results indicate that, under the evaluation system whose main output indicators are short-term economic efficiency and the number of patents, electronic computers and office equipments is relatively the most efficient, secondly medical and pharmaceutical products, medical treatment instrument and meter, thirdly electron and communicate equipments, and aviation and aircrafts manufacturing is relatively the least efficient.

Keywords: high-tech industry, technical efficiency, data envelopment analysis.

1 Introduction

Technological progress is the most important factor for achieving sustained economic growth, which has become a well known fact. Developed countries, such as the United States, Japan and Germany, their economic supremacy are inextricably linked with their leadership position in the high tech industry. China is still dominated by labor-intensive industries, but the extensive mode of development has been unable to maintain our long-term sustained economic growth. Economic structure is facing the pressure of transition. Therefore, strengthening the construction of high-tech industry is a strategic and necessary selection to enhance our international competitiveness.

Although China's high-tech industry has a certain scale, the overall strength is still weak. And the development of the industries is unbalance. Especially the efficiency of industry is not yet compared with developed countries. High-tech industry accounts too low for the proportion of national GDP. Therefore, improving the efficiency of China's high-tech industries, and enhancing overall competitiveness is the focus of China's industrial development strategy, and it is an important issues needed to be solved.

In this paper, we analyze the input-output efficiency of 15 high-tech industries at the first time, using DEA methodology based on the data of "Basic Statistics on Scientific and Technological Activities Funds of Large and Medium-sized Industrial Enterprises in High-tech Industry (2008)".

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The main structure of this paper is as follows: in Part 2, we will introduce the definition and classification of high-tech industry; in Part 3, DEA methodology is introduced; the data collection and variables introduction is in Part 4, as well as empirical analysis by DEA; at last, we will draw some conclusions from the empirical results and put forward corresponding policy suggestions.

2 High-Tech Industry

2.1 Definition of High Tech

High tech is technology that is at the cutting edge: the most advanced technology currently available. The adjective form is hyphenated: high-tech or high-technology.[1]

There is no specific class of technology that is high tech - the definition shifts over time — so products hyped as high tech in the 1960s would now be considered, if not exactly low tech, then at least somewhat obsolete. This fuzzy definition has led to marketing departments describing nearly all new products as high tech.

2.2 Classification of High-Tech Industries

According to the National Bureau of Statistics of China, the classification of high-tech industries is as follows: (1) Medical and Pharmaceutical Products, including Chemical Medicine, Traditional Chinese Medicine and Biology, Biochemistry Products; (2) Aviation and Aircrafts Manufacturing; (3)Electron and Communicate Equipments, including Communicate Equipments, Radar Equipments, Broadcast and Television Equipments, Electronic Parts, Electronic Organs, Household Audiovisual and Other Electronic Equipment; (4) Electronic Computers and Office Equipments, including Electronic Computer and Electronic Computer Peripheral Equipments; (5) Medical Treatment Instrument and Meter, including Medical Treatment Equipments and Instruments, Instruments and Meters.

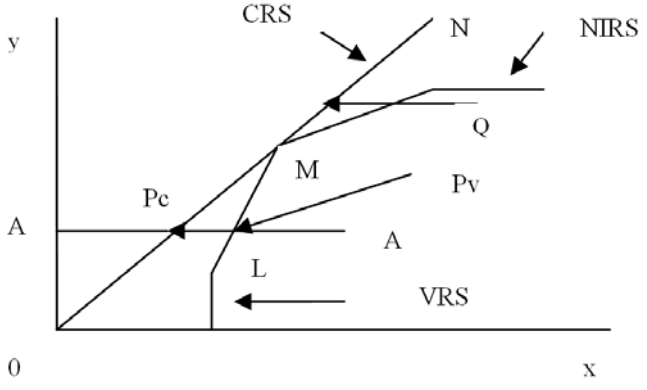
3 Data Envelopment Analysis

Data envelopment analysis (DEA) is the non-parametric mathematical programming approach to frontier estimation. The piecewise-linear convex hull approach to frontier estimation, proposed by Farrell (1957), was considered by only a handful of authors in the two decades following Farrell's paper. Authors such as Boles (1966) and Afriat (1972) suggested mathematical programming methods which could achieve the task, but the method did not receive wide attention until the paper by charnes, Cooper and Rhodes (1978) which coined the term data envelopment analysis (DEA). There has since been a large number of papers which have extended and applied the DEA methodology. Charnes, Cooper and Rhodes (1978) proposed a model which had an input orientation and assumed constant returns to scale (CRS). Subsequent papers have considered alternative sets of assumptions, such as Banker, Charnes and Cooper (1984) who proposed a variable returns to scale (VRS) model.

[1] http://en.wikipedia.org/wiki/High_tech

Assume there is data on M inputs and S outputs on each N firms or DMUs (decision making unit) as they tend to be called in the DEA literature. For the j-th DMU these are represented by the .vectors X_j and Y_j respectively. The M×N input matrix, X, and the S×N output matrix, Y, represent the data of all N DMUs. $X_{ij} > 0$ represents the i-th input of the j-th DMU （DMU_j）, $Y_{rj} > 0$ the r-th output of the j-th DMU （DMU_j）. u is an S×1 vector of output weights and v is M×1 vector of input weights. And $X_{ij} > 0$, $Y_{rj} > 0$, $u_r > 0$, $i = 1,2, \ldots, m$, $r = 1,2, \ldots, s$, $X_j = (x_{1j}, x_{2j}, \ldots, x_{mj})^T$, $Y_j = (y_{1j}, y_{2j}, \ldots, y_{sj})^T$, $j = 1,2, \ldots, n; v = (v_1, v_2, \ldots, v_m)^T$, $u = (u_1, u_2, \ldots, u_s)^T$.

The purpose of DEA is to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or below the production frontier, as shown in Fugure 1.



To select optimal weights we specify the mathematical programming problem:

$$\max \quad h_{j_0} = \frac{\sum_{r=1}^{s} u_r y_{rj_0}}{\sum_{i=1}^{m} v_i x_{ij_0}}$$

$$s.t. \quad h_j = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1, \qquad (j = 1, 2, \ldots, n)$$

$$v = (v_1, v_2, \ldots, v_m) \ge 0, u = (u_1, u_2, \ldots, u_s) \ge 0$$

This involves finding values for u and v, such that the efficiency measure of the j-th DMU is maximized, subject to the constraint that all efficiency measures must be less than or equal to one.

Using the duality in linear programming, one can derive an equivalent envelopment form of this problem:

$$
\begin{aligned}
&Min\theta \\
&s.t. \quad \sum_{j=1}^{n} \lambda_j X_j + S^- = \theta X_0 \\
&, \qquad \sum_{j=1}^{n} \lambda_j Y_j - S^+ = Y_0 \\
&\lambda \geq 0, \sum_{j=1}^{n} \lambda_j = 1, j = 1, 2, \ldots, \mathrm{n} \\
&S^+ \geq 0, S^- \geq 0
\end{aligned}
$$

Where θ is a scalar and λ is a N$\times$1 vector of constants. This envelopment form involves fewer constraints than the multiplier form ($M + S < N + 1$), and hence is generally the preferred form to solve. The value of θ obtained will be the efficiency score for the j-th DMU.

θ obtained by CCR model is called overall technical efficiency, and θ obtained by BCC model is called pure technical efficiency, and scale efficiency (SE) :

$SE_K = TE_K / PE_K$

4 Empirical Analysis

4.1 Data Collection

The data that we use for empirical analysis is from China Statistical Yearbook 2009 and the web site of Chinese National Bureau of Statistics. The data of high-tech industry is mainly from the table of "Basic Statistics on Scientific and Technological Activities Funds of Large and Medium-sized Industrial Enterprises in High-tech Industry (2008)", as shown in Table 2.

4.2 The Choice of Input and Output Indicators

The input and output indicators of the decision making unit (DMU) are the key factors to measure the DMU's efficiency by Data Envelopment Analysis (DEA). So, it is very important to select the input and output indicators and it determines the accuracy of the final measure of DMU's efficiency. According to the characteristics of input-output of high-tech industries and the availability of existing data, the input indicators which we choose for research include Full-time Equivalent of R&D Personnel (man.year), Expenditure on Technological Activities (10 000 yuan) and Expenditure for Technical Renovation (10 000 yuan), and the output indicators include Gross Value of Industrial Output (10 000 yuan), Revenue from Principal Business (10 000 yuan) and Patent Applications (piece).

4.3 Empirical Results

Based on the data of high-tech industry from the table of "Basic Statistics on Scientific and Technological Activities Funds of Large and Medium-sized Industrial Enterprises in High-tech Industry (2008)", we get the overall technical efficiency, pure technical efficiency and scale efficiency of high-tech industries in China by DEA model. The empirical results are as shown in Table 1 and Figure 1.

Table 1. The Efficiency of High-Tech Industries in China (Based on DEA Model)

Industry	crste[2]	vrste[3]	scale[4]	Returns to scale
Medical and Pharmaceutical Products				
Chemical Medicine	0.787	1.000	0.787	Decreasing
Traditional Chinese Medicine	1.000	1.000	1.000	Constant
Biology, Biochemistry Products	1.000	1.000	1.000	Constant
Aviation and Aircrafts Manufacturing				
Aviation and Aircrafts Manufacturing	0.185	0.222	0.832	Increasing
Electron and Communicate Equipments				
Communicate Equipments	0.792	1.000	0.792	Decreasing
Radar Equipments	0.329	0.964	0.342	Increasing
Broadcast and Television Equipments	1.000	1.000	1.000	Constant
Electronic Parts	0.607	0.726	0.835	Decreasing
Electronic Organs	0.759	1.000	0.759	Decreasing
Household Audiovisual	0.548	0.680	0.806	Decreasing
Other Electronic Equipment	0.528	0.605	0.873	Increasing
Electronic Computers and Office Equipments				
Electronic Computer	1.000	1.000	1.000	Constant
Electronic Computer Peripheral Equipments	1.000	1.000	1.000	Constant
Medical Treatment Instrument and Meter				
Medical Treatment Equipments and Instruments	1.000	1.000	1.000	Constant
Instruments and Meters	0.695	0.863	0.805	Decreasing
Mean	0.749	0.871	0.855	

[2] crste = technical efficiency from CRS DEA
[3] vrste = technical efficiency from VRS DEA
[4] scale = scale efficiency = crste/vrste

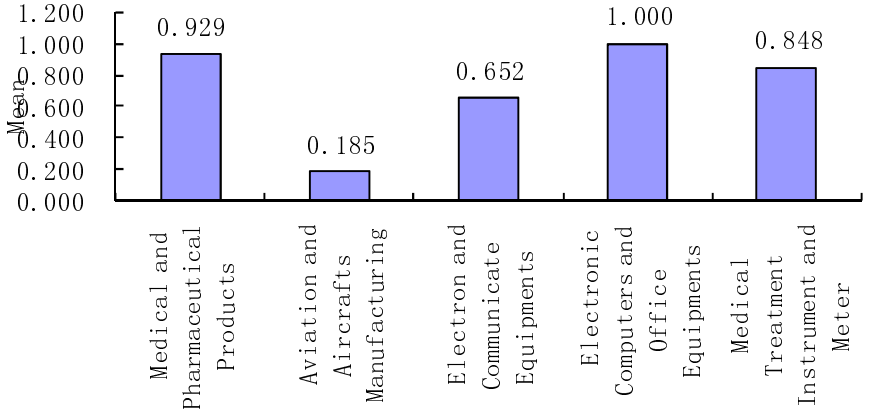


Fig. 1. The Mean of Technical Efficiency of High-Tech Industries

Table 2. Basic Statistics on Scientific and Technological Activities Funds of Large and Medium-sized Industrial Enterprises in High-tech Industry (2008) (10 000 yuan)

Industry	Gross Value of Industrial Output	Revenue from Principal Business	Patent Applications (piece)	Full-time Equivalent of R&D Personnel (man.year)[5]	Expenditure on Technological Activities	Expenditure for Technical Renovation
Total	472955004	21476940	39656	264677	10119174	2186000
Medical and Pharmaceutical Products	47990220	5357428	3917	35766	1343599	513721
Chemical Medicine	29688031	3219419	1587	21808	868991	319890
Traditional Chinese Medicine	11009008	1222623	1751	9605	285936	118326
Biology, Biochemistry Products	3720858	560944	254	2428	113596	34834
Aviation and Aircrafts Manufacturing	11041710	594162	1036	15714	913529	332520
Electronic and Communication Equipment	236779995	8732584	25909	164163	5705014	1038023
Communication Equipment	76371106	2691912	16159	91384	2393904	96466

[5] Full-time Equivalent of R&D Personnel (man.year), Expenditure on Technological Activities (10 000 yuan) and Expenditure for Technical Renovation (10 000 yuan), and the output indicators include Gross Value of Industrial Output (10 000 yuan), Revenue from Principal Business (10 000 yuan) and Patent Applications (piece).

Table 2. (*continued*)

Radar Equipments	1208343	105809	70	2690	71484	19726
Broadcast and Television Equipments	2604408	122560	600	2220	68896	2197
Electronic Parts	55053705	1558776	3273	18328	1112222	263182
Electronic Components	63061630	2871729	2057	22096	986605	266726
Household Audiovisual	32130684	1024950	3189	19532	888208	308690
Other Electronic Equipment	6350120	356848	561	7914	183696	81035
Electronic Computers and Office Equipments	155877179	4968032	4540	29086	1468869	103750
Electronic Computer	88070621	1897654	1171	13755	660285	41281
Electronic Computer Peripheral Equipments	57308539	2364266	2674	9682	647038	52846
Medical Treatment Instruments and Meters	21265900	1824734	4254	19948	688163	197987
Medical Treatment Equipments and Instruments	4156971	498990	1326	2912	144689	17673
Instruments and Meters	17108929	1325744	2928	17036	543474	180314

5 Conclusions

We analyze the input-output efficiency of 15 high-tech industries using DEA methodology based on the data of "Basic Statistics on Scientific and Technological Activities Funds of Large and Medium-sized Industrial Enterprises in High-tech Industry (2008)", and the first time choose 15 high-tech industries as decision making unit. The empirical results show that:

- The efficiency of China's high-tech industry is relatively high. The mean of overall technical efficiency is 0.749, mean of pure technical efficiency is 0.871 and mean of scale efficiency is 0.855.
- As shown in Figure 1, electronic computers and office equipments is relatively the most efficient, secondly medical and pharmaceutical products, medical treatment instrument and meter, thirdly electron and communicate equipments, and aviation and aircrafts manufacturing is relatively the least efficient.
- Specifically, traditional Chinese medicine, biology, biochemistry products, broadcast and television equipments, electronic computer, electronic computer peripheral equipments and medical treatment equipments and instruments is the most efficient and they get the score of 1.000; aviation and aircrafts manufacturing and radar equipments are the least efficient, aviation and

aircrafts manufacturing gets 0.185 of overall technical efficiency and 0.222 of pure technical efficiency, and radar equipments gets 0.329 of overall technical efficiency and 0.342 of scale efficiency .

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Research on Cultivation Model of the Computer Science Undergraduate Talents: Oriented to Foster Engineering Practice

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Abstract. In recent years, many graduates have trouble finding a job, at the same time, enterprises are hard to look for employees they want. In this paper, we focused on the "last mile" problem between universities and enterprises, and proposed a "3+1" cultivation model of engineering practical ability-oriented. Besides, the teaching content, teaching system and industry-university research cooperation attached with this model are studied in depth. Through establishing "3+1" training model, the rate of employment of computer science major and the quality of employment have been greatly improved. The proposed model also can provide reference value to implementation of the plan of cultivating excellent engineers in China to some extent.

Keywords: cultivation model, engineering practical ability, teaching system reform, excellent engineer.

1 Problems Exist in the Traditional Undergraduate Training Mode

In recent years, colleges and universities have continued to improve their training programs, yet there is still a large gap from the social development needs. The rapid development of science and technology forces the requirements of the current social talents to have a solid, in-depth basic theory, and that dedicated to professional counterparts and professional career. To add it, GM's engineering capabilities are also required to be combined with strong vocational and technical skills to meet their counterparts in the professional career. That is, the business is in short supply of top complex talents in creation and application. Our colleges and universities' plan for talent training still has a big gap in several areas including "complex", "professional theory", "vocational and technical capacity". College graduates, especially those specialized in automation, computers and other general majors, generally in lack of engineering practice that is corresponding with the jobs. It is difficult for them in such a short time, to integrate themselves into an enterprise development team, as their knowledge gained in the school being that are difficult to be used to solve practical technical problems. This leads to the contradiction between the personnel training in universities and the social needs, and it has become a serious problem in higher

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education. Many employers believe that "college-trained people are not what we need, and we really need the people beyond the reach of the colleges and universities." On the one hand, it is the waste of "human" resources; on the one hand, the business is always on the lookout. Both universities and businesses are stuck in a stalemate of the "talent" supply and demand [1]. This contradiction shows that the current problems in China are commonly found in many colleges and universities in terms of training model, which should naturally be further explored for a change.

Meanwhile, in today's society a large number of continuing education institutions have gained their positions, aiming at enterprises to train specialized personnel that are equipped with strong engineering practice, familiar with the employment units in production mode and with a solid theoretical foundation and from which, they gain a high interest. Most students of these institutions have their participants from the senior students in colleges and universities. Imagine a student graduating from regular colleges and universities even need to receive "re-training" through a social institution, which is not so stable and lack in a fixed experimental base for teachers and places before getting the social recognition. This illustrates the problem, from another aspect, that are present in training model of higher education, i.e., the current higher education fails to meet the actual needs of the community with respect to application-oriented training. It has ignored the cultivation of engineering practice capability, where the curriculum content does not keep up with the pace of social development, whilst teaching methods and means, experiments, as well as the training content and methods are all in need of a thorough reform.

At present, many students of vocational training institutions are most popular by companies because they focus on engineering practice, and the students are trained with a strong working ability [2]. Vocational schools are a new product, which can give a serious thought to the needs of society, while absorbing the successful experience of overseas countries to overcome many problems that may be found in domestic training model. Nonetheless, students on this level generally don't have a solid theoretical basis. This is sufficient to determine that such training of students is mostly for technical workers. Here it can give us a prompt idea: why not the cultivation of undergraduate students merits the vocational training and social experience, enabling our students with a profound theoretical basis and a strong engineering practice?

In 2010, Chinese Ministry of Education clearly stated a "Program for the Excellent Engineer Training" in the "The State's Long-term Education Reform and Development Plan (2010-2020)", which is perhaps purposed to resolve the current serious problems. It is understood that the "Excellence Program" features three aspects: First, the depth of industries and enterprises involved in the training process, and second, development of engineering talent by the school according to common standards and industry standards, third, students to be enhanced with respect to their engineering and innovation capabilities.

Due to this, in-depth study on China's higher education, especially the training model for computer science undergraduates, is of great significance as the key issues in the urgent need to be addressed.

2 Our Teaching Mode of Computer Science

To seek a breakthrough on the assistance of the students in engineering practice, we conducted a survey on some U.S. research universities and national universities, upon which we explored the teaching content, teaching system, training ideas, etc., and achieved satisfactory results.

2.1 Ideas for Developing the Practical Ability of Talents

By analyzing the needs of the community and the status quo of students, the main goal was made on "developing application- oriented talents with a highly professional and theoretical knowledge and significant engineering practice to adapt to regional economy." For application-oriented talents, the required core competencies include engineering practice skills, teamwork skills, foreign language proficiency and technical innovation, of which the most important is engineering practice. In recent years, we have found a way for self-development training of computer science engineering practice. The main idea can be summed up in three areas:

(1) Following the social needs, timely reform of the personnel training program to lay the foundation for application-oriented training.
(2) Based on scientific, systematic practice of teaching system, personnel training programs are built to guarantee the realization of application-oriented training objectives.
(3) Completion of the second class and performing of research activities to expand the education space for engineering practice ability.

In order to achieve these goals, we proposed the following measures to protect the application-oriented training:

(1) The concept of project-based training is introduced to guide the construction of the teaching laboratories, aiming to provide infrastructure support for the practice of teaching.
(2) The ability of teachers in the engineering practice is enhanced to improve the teaching practice of educating people.
(3) The practice of teaching content is strengthened to enhance the personnel training regarding the project adaptability.
(4) The reform of the teaching methods and means should be actively carried out to lay the foundation for the all-round cultivation of the student ability in engineering practice.
(5) The link to practice teaching should be enhanced by careful organization and implementation of standardized management.

Since 2005 we have been active in exploration and practice for the training mode of application-oriented talents in computer science, and gradually found out a way for our own development of application-oriented talents that are equipped with a strong computer science engineering practice. Along with the implementation of the employment of our 95% of the students in computer science 2005, the exploration has achieved initial results.

2.2 Reform of Teaching Content and Teaching System

Based on years of experience in training application-oriented talents in computer science and technical expertise, we proposed the following training model: "The market demand is taken to drive the reform of the theory of teaching content, and the actual project development to drive the reform of teaching content and practice teaching methods, whilst strengthening of interpersonal communication skills is combined with training of team spirit, followed by the school-business cooperation to implement the 3 +1 joint training". Meanwhile, based on the teaching needs of this training mode, a series of investigations and studies were carried out for a full range of teaching reform.

(1) Reform of teaching content and teaching system. In the guidance of professional standards developed by "Computer Science and Technology Teaching Steering Sub-Committee" under the Ministry of Education, combined with the school's guiding ideology and personnel positioning requirements, we carried out a bold reform and innovation in curriculum and teaching content. In the premise of ensuring major courses teaching content, theoretical course content was reduced, while increasing the proportion of practice teaching, making the practice of teaching credits accounting for up to 40 per cent. A large number of elective courses were set up on the current development tools and the industry's hottest development platforms. Additionally, re-examining the curriculum was made to eliminate duplication of teaching content.

(2) Reform of teaching methods orientated at the ability of students. In the reform of teaching methods, the author is trying out new school-enterprise cooperation. Specifically, well-known social training institutions are being explored for course substitution. By cooperation with the well-known manufacturers, the practice of joint teaching may allow part of the strong practice curriculum to be arranged in the laboratory, implementing "talk and practice".

(3) Strengthened reform of computer practice teaching. In the training mode, the "3 +1" training model was proposed as follows: In the first three years of school teaching, business teaching resources are gradually introduced to the school (where curriculum based on the capacity needs of the business professionals, and the technical personnel of enterprises are employed to the school for teaching, guiding the curriculum design and academic seminars from time to time). The last year will see the implementation of enterprise-based teaching, taking the project development as the main content. At the same time, positive contact is made with the domestic well-known IT companies to explore new school-enterprise cooperation.

2.3 Reform of the Practice Teaching Link

(1) School-enterprise cooperation to establish training bases. More companies were contacted to establish long-term school-enterprise cooperation, making enterprises the school's practice base. Thus, the school's investment can be practically reduced, from which students can benefit a chance to be exposed to the actual posts. At the same time, enterprises and schools coming into the training base increases the confidence of school-enterprise cooperation. Through various efforts, we have made contact with many large computer companies, and built a platform for students to practice and established a long-term computer science practice base. Additionally, the short- and

long-term training cooperation have been established with some of the training institutions to meet the needs for students to further their studies.

(2) School-enterprise cooperation used to introduce the projects into the classroom. In order to ensure the effectiveness of curriculum design and further improve the quality thereof, curriculum design questions were asked as far as possible to be taken from the business and research projects so that the enthusiasm for business to aid teaching can be mobilized. And in large part, deviation from the practical training objectives can also be avoided, so that students are able to really put what they learned into use. Through the cooperation with well-known enterprises, enterprises may bring the school with the actual projects, which are then arranged into the teaching program and into the curriculum design link, making up for the lack of practical aspects of students.

(3) Promoting competition to mobilize the enthusiasm of students for participating. In extra-curricular, competition projects related to social practice were designed, such as Professional Skills Contest, Project Challenge, Creative Competitions, etc. Interesting projects are able to stimulate the competition enthusiasm of students to put theory into practice actively, thus effectively improving their quality and ability.

(4) Activities of “race substituted by course” [3] held to improve their practical abilities. For many courses highly featured in the practical and operational nature, the teacher counseling plus self-learning were both applied with the success of the projects to substitute the corresponding course grades. This, apart from the enthusiasm of students being greatly improved, trained the working ability of students, with their self-learning ability also increased.

(5) Laboratory fully open to help improve students’ self-learning ability. To enable students to better accomplish their extra-curricular subjects and the major operation tasks arranged by teachers, laboratory is viewed an indispensable tool. Meanwhile, more students entering the laboratory may gain in-depth understanding of theoretical knowledge to enhance the practical ability of operations.

(6) Addition of design and innovative experiments. As a stimulus to students 'motivation to learn, we added a lot of choices and optional pilot project to improve students' ability of innovation, in addition to an increased number of comprehensive and innovative experiments. After several years of operation, student’s learning motivation and learning initiative have both been greatly improved.

(7) Reform of the assessment methods for practical courses. Rather than teaching purposes, course examination is only a means to check the students' learning effects. Apart from the paper assessment methods, we have increased the laboratory site assessment, accomplishing the work within the stipulated time, report writing, etc. Through the library use and the Internet search on information, the ability of students in searching and synthesizing the information and documentation were improved, hence avoiding the students to pursue the rote knowledge.

(8) Formation of the innovative team. According to their interests and hobbies, the students were divided into several interest groups, in which students could help each other. Within the team, master may help train an apprentice, while the senior works with the junior. Teachers should learn to let go, and not the same as the nannies [4]. Sometimes teachers may emphasize the knowledge points several times, which still

cannot be grasped by the students. The interesting thing is that once demonstrating among students may enable them to keep those points in mind. As a result, a teacher becomes more. In companion, the help of the students can make the progress almost exceptionally fast; and fellow students with a relatively high level of technology in the guiding process, are not only able to enjoy the thrill of success, but also to make their technology more skilled. For a given project, the students can realize the location and division of labor based on their own situation, thus greatly improving the students' enthusiasm for learning and innovation.

(9) A period of one year of graduation design. The core of "3+1" is last year's arrangement, where a variety of methods may be adopted, such as graduate students to contact the design units on their own, the school to contact the design units, or the school to organize some students to undertaken other project development in school. For students who are able to contact the graduate design units on their own, or who have signed employment agreement, may leave the school for graduation design after going through relevant procedures. For those who cannot contact the design units on their own, schools and enterprises can organize students to participate in graduation design. Off-campus students who do not want to participate in the design may be arranged to participate in campus development projects. Thus, through year of graduation, students are capable of applying the theoretical knowledge learned in the previous three years into a real project, not merely greatly improving their ability to engage in enterprise development projects, but also the ability to exercise the solidarity and cooperation of students.

2.4 "3 +1" Training Model – Exploration for Reform

With the development of higher education, new teaching models under study and practice have become a hot spot of China's higher education reform. Application-oriented undergraduate is measured with the sufficiency of the main theories, being practical as training objectives. However, the school could do nothing when facing the "last mile" between schools and enterprises. To this end, we proposed the "3+1" training model, in an aim to explore the problems found within.

2.5 Exploring the Ways of Cooperation with Enterprises and Continuing to Develop and Improve the Quality of Teachers

In order to enhance the level of teachers, the "Go out and invite" model is used to explore two solutions to enhance teacher capacity. On the one hand, teachers are allowed to participate in the corporate learning, and then back to training for school teachers; on the other hand, the business front-line technical experts are invited into the schools to give lectures to the teachers, providing hands-on help.

2.6 Mode of Cooperation on Production, Teaching and Research

Research and analysis may be focused on four models: productive forces, schools and enterprises to jointly build research institute and a technology center and a training base. At the same time, some basic principles have been given for the government, enterprises, colleges and universities as research partners and research institutions that should be followed to ensure that the research cooperation achieve tangible results.

3 "3 +1" Teaching Model: Reform Measures as Protection

3.1 Reform of the Curriculum and Improvement of the Quality of Teachers

Concerning the curriculum, market-oriented economy is closely integrated with the market demand to avoid being unrealistic. Further efforts should be made on teacher training to improve teacher quality and to enhance teachers' knowledge base of new knowledge and new technologies, so as to create a group of high level of teachers. Thus, they are able to follow the latest concepts on computer science and technology in international development, with the latest information to be imparted to students.

3.2 Student-Centered Teaching

More than respect for each student, students should be encouraged to actively participate in class discussions about teaching content, and the reform on curriculum and pedagogy. In their studies, students are given maximum autonomy and initiative, whilst appropriate to reduce the total hours for classroom instruction, and arrange some extra homework to increase student learning time. Students are encouraged more in extra-curricular reading, writing and participating in various social activities in order to achieve the goal of self-learning, training and improvement.

3.3 Flexible Ways of Course Examination

In the curriculum assessment for students, we pay attention to the usual results and the actual ability. Depending on the course situation, teachers are given more autonomy to set flexible assessment methods. Focus is made on a combination of education and the school to assess students in practice by increasing knowledge and practical application, thus to change the status quo of being merely concerned about book knowledge assessment, being separate from learning to use.

3.4 Great Importance to Cooperation on Production, Teaching and Research

In the cooperation on production, teaching and research, student and teachers are encouraged to participate in research projects, by which teachers can discover students' interest and expertise, so that students can learn to ask questions, solve problems, and finally have their creative skills improved. More opportunities and business cooperation should be created to allow students to be thoroughly practically and directly involved in scientific research and engineering practice. Through cooperation with enterprises, not only the company's employment costs are lower, but also the students are beneficial in receiving training to become the talents tailored for business needs.

4 Conclusion

This paper is designed to explore the issues on the theory practice gap that currently exists in colleges and universities. Through research on the U.S. computer professional training system, the "capacity-building & engineering practice-oriented training model for computer science undergraduate" is proposed. Meanwhile, starting from our school

teaching reform, in-depth study was performed in the aspects of human practical capacity-building ideas, teaching content and teaching system reform, reform of practice teaching link and the reform measures. Future work will continue to focus on subject objectives, in-depth study of the "3+1" mode for "training application-orientated computer science undergraduates of significant engineering practice." Reform curriculum will be combined with a wide range of modes of cooperation to carry out research on "policy, production, teaching, research, and practice." Research results will be widely applied to the undergraduate teaching practice. It is expected to play a role in promoting the training model for the reform of the computer science undergraduate talents in our colleges and universities. More than that, it will also have an effective reference in the formulation of the computer science excellent engineer training program.

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A Curriculum Design on Open Source Software for the C Language Programming

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Abstract. The C language is the most popular computer programming language introduced in most Chinese universities. A lot of undergraduates are absorbed to devote themselves to this domain in years. Generally speaking, most undergraduates are deficient in the background knowledge about the C's essence. In order to achieve the essential knowledge, we have a curriculum on the C language programming lecture for the students in their fourth term. After surveying the same curriculum of many colleges we found that most of them were focusing on the basis and syntax of C language programming, few on programming skills training. The students, actually, didn't interest in learning the simply syntax or basic statement in that they lost impulsion to master this beautiful computer programming language in our empirical results. As reforming the curriculum year by year, we have attempted to include vital open source software to show the programming essence of C language to students and instruct them to think about the language, learn the skills of development method and research issues. It is the hardest challenge for most students because they are used to the IDE in Windows operating system and lack of software engineers with experience in open source methodologies. Unfortunately open source software' toolkits provide unique opportunities for less experienced software engineers to gain experience solving real-world problems. So some effective methods or mode should be used in curriculum by lecturer. This paper mainly discuss about how to impart the C language programming to the students on open source software. According to a survey of students went through this curriculum in recent years, it shows the teaching effect is quite good for most students to master the C language programming.

Keywords: open source software, C programming lecture, computation, GNU.

1 Introduction

C language is a computer science and related fields important professional basic course in colleges. But nowadays most teachers adopt the Windows platform software such as Visual C++ to teach computer programming techniques, there is no possibility to be explained in-depth and master the essence of c language programming in that most undergraduates only engaged in some simply and facial jobs when they seek jobs after they graduate from colleges, vice verse most deep-level technical must be

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developed or completed by the engineers abroad which has greatly hindered the development of computer technology in China. As a bearer of technology the colleges and universities should take some reforms in normal teaching procedure and show the students the essence of the C language programming in detail, at the same time abandoning the integration development environment such as Visual C++, Delphi, Power Builder and so on.

There are many excellent domestic enterprises to develop their own businesses products based on open source software, many products are developed under some very rudimentary tools rather than using Visual C++ which is a commercial and powerful integration development environment (IDE). In despite of these open-source tools is not very high-integration and not easy to use, each tool in the development of various stages of a product play a different role and display the programming feathers, simply but practical. If in the class students can master all the open-source tools, they will well know and grasp the whole product development process core so we have the technology to develop and others.

Combined with the feather of service the capital and the purpose of construction our capital, a new teaching mode must be explored to realize our students seamlessly transferring from a student to an engineer before they just graduate from college. This paper will discuss how to learn by doing in practice and how to make students improved by using practice which is skipping the tedious theory and focusing on ability of manipulative, expression ideas and so on. Only in this method we could change the status of our students when they seek jobs, only in way they will be more suitable for their future career' needs. Under the help and encouragement of our school, an effort is made in the language C programming course adopting many free open-source tools of GNU to teach students the language C programming techniques in different aspects to show the essence of this kind language. According to the years teaching experiments we practiced using open-source tools in class is necessary and effective.

2 Compile with GCC

Each program written in high-level language must be compiled in to low-level computer instructions. The compiler translates the C source code into instructions that make sense to the computer. These instructions are known as machine language or object code. Source code is for programmer; machine language/object code is for the computer. Students write the source code using an editor called Vim, and then the compiler translates source code into a machine-readable form. But many students using some like Visual C development tools don't know this details, they just know "please click this and click that button", because the IDE help us do that thing too far. If we use the simply and rustic Gcc compiler and instruct students to adopt various compile-parameters in different steps and purpose from source code files into the computer executable images. They will truly know the procedure of the build procedure of our application.

In the lecture, we introduce some parameters of the complier such as –E, -S, -o and so on, so they could understand why we should write <stdio.h> in source codes before the function ***main*** and know there are so many steps happened when programmer

compile a source code. After the students master all the Gcc's parameters, they will get a conclusion that these stages can be filtered down to four: preprocessing, compiling, assembling, and linking. In the preprocessing stage, the source file (*.c) is preprocessed with the include files (.h headers). At this stage, directives such as #ifdef, #include, and #define are resolved. The result is an intermediate file. Usually, this file isn't externally generated at all, but it is shown here for completeness. With the source file now preprocessed, it can be compiled into assembly in the compiling stage (*.s). The assembly file is then converted into machine instructions in the assembling stage, resulting in an object file (*.o). Finally, the machine code is linked together (potentially with other machine code objects or object libraries) into an executable binary. To illustrate how to compile a source code file into a executable image by using Gcc in class, we make a example to instruct students to try to use like the following:

$ GCC test.c -o test
Here you compile the test.c file and place the resulting executable image in a file called test (using the -o output option). But if instead students wanted just the object file for the source, they could use the -c flag, as follows:

$ GCC -c test.c
By default, the resulting object is named test.o, but wan to force the output of the object to newtest.o, as shown here:

$ GCC -c test.c -o newtest.o
Most programs more than one file we told students that GCC handles this easily on the command line as shown here:

$ GCC -o image first.c second.c third.c
Here we could compile three source files (first.c,second.c, and third.c) and link them together into the executable named image.

By going through using Gcc, students could master the whole developments process in detail and strengthen their self-confidence, improving their study interest and programming ability.

3 Project with Makefile

Students always found that many enterprise need experienced engineers in project, what's project experience? Just we should develop some projects? No, the enterprise need in deed is that engineer should know how to treat a project or a problem in a systematic opinion. How can a project within so many source code files build into a single executable image? Engineers should know the process of building the projects.

Creating a binary in a compiled language often involves lots of steps to compile all of the source files into an object code and then invoke the linker to put the object code modules together into an executable image. The necessary steps can all be performed by hand, but this becomes tedious very quickly. The developers of Linux recognized this requirement early on and developed a utility named ***make*** to solve this problem. The GNU ***make*** utility provides a way to automatically build software based upon defined source files, source paths, and dependencies. A good understanding of make

and how it operates is an essential skill in any modern software development environment. In class we provided a brief introduction to some of the capabilities of the GNU *make* utility to build up some concepts such as project, module in their minds.

4 Debug with Gdb

An important part of software development is testing and troubleshooting. In a large program, programming errors, or bugs, are practically inevitable. Programs can deliver wrong results, get hung up in infinite loops, or crash due to illegal memory operations. The task of finding and eliminating such errors is called debugging a program. Many bugs are not apparent by simply studying the source code. Extra output provided by a testing version of the program is one helpful diagnostic technique. This skill just needs experience not theory, newer should practice more, but in colleges there is no such course to teach students debug a program. In the C language course, we introduce the Gdb debugger to them. Students can add statements to display the contents of variables and other information during runtime observing the contents of variables, memory locations, and CPU registers after each statement and can also analyze the sequence of function calls that lead to a given point in the program.

The teaching practice shows that the introduction of Gdb debugger in the learning process of the C language programming can enable students to develop their independent thinking skills, and get into the habit of solving problems all by themselves.

5 Useful Tool-Chains Display C's Charm

The C language program course is a very practical course, and also has a difficulty in understanding of the course's essence, but if we could explain a knowledge point to students from multiple angles or aspects it will certainly be able to help students better understand the C language. In the open-source software world, there are a lot of small tools can easily impart the nature of C language to students from all aspects of. For example, we can use vim editor to write the two characters ab and save it as **ab.c**, then use the command ***cat ab.c*** to print out the contents of the file on the screen, use ***od ab.c*** to printe the document on the screen in octal means, using 16 hexadecimal command ***hexdump ab.c***. All these commands are just printing the same thing but in multi-angle to understand the nature of one thing which makes the students' "wanted me to learn" become "I want to study".

6 Conclusion

Teacher must explore some methods to teach in order to help students to learn. Using open source software to teach the language C in course could make students thinking more, practicing more and interactive more to learn the C's essence in different point

of viewpoint, and also could raise the computer language course's teaching quality and teaching result to satisfy their curiosity, so as to achieve better teaching results and effective.

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Situation and Reform of Multimedia Teaching

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Abstract. By analyzing the current situation of multimedia teaching, inadequacies which exists in multimedia teaching is pointed out: the teacher is take as main subject, and multimedia teaching software is taken as Led, but the dominant position of student is ignored. So, a corresponding theoretical solution method is brought forward in the paper. By promoting the method in the teaching, multimedia teaching software is created more and more practically, and effectiveness of multimedia teaching is more and more good.

Keywords: multimedia assisted teaching, mathematics leaning mode, constructivism, multimedia courseware.

1 Introduction

With the advance of computer and multimedia technology, multimedia teaching that computer is made as main body is also becoming increasingly popular. The advantage of multimedia teaching is obvious. It does not change the familiar and customary teaching form between teachers and students, and teaching subject easily adapts and will not cause too much psychological pressure. Graphics, text, sound, images, video and other multimedia information is integrated to make teaching vivacity and clear, which can effectively attract and retain the attention of students, and teachers are able to increase the teaching content and can reduce hours and so on. But these are not all multimedia teaching, the author lectures found that the current multimedia teaching has a lot of problems need to be resolved by several of the quizzes.

2 Present Situation of Multimedia Teaching

Teaching philosophy and learning mode are old and do not meet the information social teaching. With the rapid development of social economy, colleges and universities have form a expanding teaching mode that training is becoming more diverse, multi-layered. The traditional teaching uses the form that teachers teach and students receive, which results in students are passive to accept knowledge, focus on accumulation and consumption of knowledge, and control a large number of public knowledge and statements. Acquisition of knowledge is characterized by a lack of learning activity. But, the study should be a long-term behavior, especially in the information society; lifelong learning has become an inevitable trend. Accelerated renewal of knowledge is

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one of the most important features in the 21st century. Authoritative international investigate views that the current human scientific knowledge doubles every 3 to 5 years which means that knowledge has learned in college is inevitable to outdate after graduation. Therefore, college education is no longer a personal end, but the beginning of another study. This requires the current study is the preparation for future learning, and learners can begin new study on the basis of the original study at any time, that is to say, learners must have the ability of continuous learning which requires to have new teaching ideas and learning mode in order to study particular attention in two aspects: one is to help learners grasp the flexible and effective learning methods, as well as with the technical means of these methods in order that learners can be carried out independently in the future; another is to pay attention to psychological development and improvement through the learning ability and acceptance.

Dynamic teaching process is electronic and teaching subject is diluted. Multimedia courseware breaks the traditional media's linear constraints, and information is presented vividly to students in an interactive and nonlinear way. Therefore, courseware can provide a good teaching and learning scenarios during the teaching process and can increase the classroom capacity and improve teaching efficiency. Currently, many universities are to increase investment, and carry out the awards of multimedia courseware in order to vigorously support the development and production of multimedia courseware. So, the number of multimedia courseware doubles year after year in the universities. This phenomenon is very encouraging on one hand, and on the other hand there are some hidden dangers. Because everyone wants to create multimedia courseware and use their own courseware, and most teachers' courseware production level is not high, so that the current terms of the multimedia courseware has a serious phenomenon of low-level and redundant construction. In order to "jump on the bandwagon" (or meet the inspection or participate in the competition award), some courseware, regardless of whether the content of teaching is suitable to use multimedia courseware for teaching, is almost a simple copy of teaching materials. Courseware pursues some novel to produce some images and music that is not related to teaching content, which dilutes the teaching subject and teaching effect.

Entry point and mode of courseware is unreasonable which distracts the attention of students. Entry of multimedia courseware must be reasonable, and convergence of between courseware and teaching language directly affect the actual teaching results. Some courseware lack the necessary overture and end; and some users do not consider the entry point of courseware from the optical, sound effects, visual effects, but a simple switch. The result is to divert the attention of students and don't conducive the completion of teaching tasks.

Overloaded information and a short residence time are not conducive to understand and memory. The use of multimedia courseware reduces the teachers' time of drawing, writing on the blackboard, and increases efficiency of classroom teaching. But, students need a certain time span to receive information and master knowledge, and rapid change of screen contents will make student lost a lot of useful information, and do not conducive student to understand, memory knowledge and improve cognitive abilities. Some courseware's producers make courseware of "water" model in order to make courseware simple, so teachers only button a mouse, the courseware will be successfully shown. This courseware is difficult to schedule flexibly according to

student's feedback, and will make teaching information flashed quickly, which can't play the role of teaching aids and should not achieve their teaching effectiveness as good as traditional teaching that writes on the blackboard.

3 The Appropriate Reform Strategy

Establishing teaching philosophy of constructivism, and focusing on interaction between teachers and students. Constructivism views that gaining knowledge is not by teachers' teaching, but in certain social situations and cultural, learners use the aid of other people (including teachers and learning partners) to make full use of various learning resources (including text materials, audio-visual materials, multimedia courseware, software tools and a variety of teaching information that accesses from the Internet, etc.), and obtain all knowledge through the meaning construction fro them. It emphasizes student-centered, and not only requires students to change from passive recipients of external stimuli and the inculcation object of knowledge to the subject of information processing and active constructors of knowledge meaning; but also requires teachers to change from teaching and instilling the knowledge to active construction of meaning to help students. That is to say, we not only pay more attention to the main role of the learner's knowledge, but also don't ignore the dominant role of teachers.

In media technology, teaching and learning model (Computer Assisted Mathematics Leaning, referred to as CAML) is the corresponding learning mode with this. It is based transfer mode of information on the modern teaching environment and students' psychological processes of knowledge to fully mobilize the support of educational technology, instructional media and information resources as much as possible in order to build a good learning environment. Under the guidance and organization of teachers, initiative, enthusiasm and creativity of students will be fully played. This can enable students to truly become active constructors of knowledge and information to achieve good teaching results.

In China, the collective culture of implication for good and peace within the personality of, so that learners generally is shy away from mouth, and is afraid to ask questions, which results in the scarcity of their learning behaviors for help. Student behavior that is generally not to question must be face for us. According to Chun Cai, Hu Zhongping's point of view, "the educational process does not allow spectators asked to participate in education itself," "education process is a process of meeting between educators, learners and education." For the three main education elements in CAML model, there is not the rights of absence for these three parts, education must be among "the presence of mutual dialogue." Only dialogue can make learners consciously participate in these learning activities. The key issue is to how to deliberately establish the dialogue atmosphere between teacher and student. Through conscious presentation for multimedia courseware and creation of easy interactive learning environment in classroom, it can stimulate desire and passion of the learning. Teachers can not always play a "teaching" and the "dialogue passive" role: as long as students do not ask questions, teachers will talk down by natural processes. Instead, teachers should be active, positive and detailed inquiry to understand true thinking of

the students under the class. When necessary, teachers can form extensive survey to understand students.

For specific "emotional interaction" approach between teachers and students, Liu Jingfu, Zhong Zhixian view that it should be reflected in the instructional design, according to the characteristics of materials, "in handling the content displayed to the appropriate use of emotion, to explore emotions, induced emotions and to give emotional strategy." In the design and development of online education materials, people-oriented concept must be set., and use of multimedia technology to create the right situation must be persisted. During students solve specific problems according to educational games, problem solving, feedback of problem, courage, confidence, self-esteem, self-compassion, kindness, integrity, hard work, responsibility, honor and other positive emotions and healthy personality can be established. It is necessary to make full use of multimedia interactivity. In the processing materials, role-playing, clever question should be used in order to enrich the emotional experience of students. For existing materials emotional factors, emotional display method using the strategy"; "hidden emotional factors for the material, the use of a strategy to explore feelings"; "materials for understanding emotional factors, the use of induced emotional strategy." No doubt, they proposed the "emotional teaching materials design strategy", is worthy of our reference in multimedia learning instructional design.

Here, we swap the roles of teachers and students, and integrate the role of psychological experience and behavior in one culture, which is known as personality interaction. Interaction of personality can not only practice each other's cultural psychology, but also find the right way of teaching, learning support and learning, whose aim is to make mutual benefit. Through the role exchange and adjustment to each other, mutual support panacea can be found. Through interactive surveys, teachers can learn all the circumstances of learners, and then "throw the peach" in the class process of design and implementation, to show their kindness to the students. During the process of developing learning plan, students imitate the teacher and realized teacher’s care and thought from their human emotional care and teaching behavior.

Courseware should be created by corps combat mode. Teaching is an art, in which multimedia courseware is reference as the art of teaching. Teachers’ teaching process is dynamic, teachers must be adjust the teaching progress and teaching methods according to teaching content, acceptance ability of students, classroom atmosphere and other factors to properly use multimedia technology. By trying to selectively handle those inconvenient that can’t handle by traditional teaching methods, you can receive good results. As an indispensable multimedia courseware production, in my view, should be implemented corps combat strategy, which focuses on the discipline of experienced teachers to develop multimedia courseware. In this way, limited human and financial resources can be focused. Unified planning and scheduling, pre-production in the courseware can be effectively carried out according to extensive research. In the process of courseware’s design, everyone's expertise can be played, which can be ineffective to prevent the waste of resources, prevent low-level redundant construction courseware and ensure the quality of multimedia courseware.

Traditional teaching and multimedia courseware teaching should be in a seamless connection. First of all, selection of courseware content should be paid more attention. Inconvenience for those using traditional methods supported by modern display

multimedia content should play their strengths which can greatly improve student interest in learning, enhance the appeal, received good teaching. For example, invisible, intangible, microstructure and its movement that less to be observed by student, we can be with the help of multimedia courseware in the form of using animation to simulate the shape and movement, and with the real world that is similar to this specific the analogy of things, students can easily observe, receive, understand, and give full play to show the dynamic effect of multimedia courseware advantage. Second, courseware content should be convenient to the transition of a variety of media, such as the transition between blackboard and screen. When courseware is design or selected , or lesson is prepared, content of transition process should be chose. It is necessary to grasp the best opportunity to entry, and does not switch too much time to cold market. It should grasp the duration of these and related factors to achieve the seamless of time. Finally, the hardware facilities should organically combine the board and multimedia computers and other media, and reasonably arrange for its spatial location, so that student's attention span should be as small as possible, and the operation should be easy switch quickly and naturally, and the visual effect is good.

Adhere to the leading role of teachers, master use of multimedia courseware for a degree. In classroom teaching, teachers are leaders, and students are subject, and the role of multimedia courseware is assisted instruction. Teachers should give full play to its leading role, and must not centralize a courseware in order to use the courseware, and is led a nose by courseware. For some teaching content, teachers must be discussed through the organization of students with appropriate body language, and deepen the theme briefly and excitingly, which is can not be replaced by any electronic media. In order to effectively play the leading role of teachers, multimedia courseware design should be strive to simplify the operation, and the main focus should not be placed on teachers to use the machine. It should be to focus on guiding students to discover, analyze and solve problems, and timely adjustment and active classroom atmosphere.

Play the leading role of teachers, and master the use of multimedia courseware for a degree. Courseware content is too much, which on the one hand easily leads to information overload and students can not accept; the other hand, which tend to weaken the dominant position of teachers and result in distracting. Courseware content is too small, which can not play the desired effect of multimedia teaching. In order to play the leading role of teachers, the use of multimedia courseware message flashed too quickly should be avoided. Computer display Chinese characters is a dynamic reading object, because of its content appear and disappear in a very short but within a period of time, so the reader must keep track of moving targets, and complete the information perception, memory and its preliminary understanding within a limited time. Clearly, from the perspective of the interaction, the traditional way of reading is subjective and controlled static mode, and dynamic ways of reading is an objective approach to adaptation, and objective way to adapt to the reading results more dependent on property set to display subtitles.

Experimental studies have shown that the rolling speed of computer’s display, font size and line spacing and other attributes have a significant effect for readers. Each attribute has a best settings range. American reading expert Frederick GR Shi Tao said: "Speed reading comprehension should be the main contents of appropriate species, in general, the correct rate of reading should be between 70% to 80%." Thus, before the

production of courseware, should extensively research reading object of courseware. In the production of courseware, each courseware should be given a appropriate time on the screen, which is convenient for teachers to play a leading role.

4 Conclusion

Use of multimedia teaching is to give students an open learning environment, which not only means to provide students more learning materials and information, more importantly, is to help students develop a new way of learning and methods. To teach students some of the information technology, and make student exposure to the sea of information, and encourage students to take the initiative to find and obtain the required content, in this process, students' knowledge is not only broaden and their learning ability can get a workout and improvement, and can help students develop initiative, positive thinking and other good study habits, so that they can take into the society faster and better.

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Computer-Mediated Communication in Education

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Abstract. Synchronous communication techniques allow participants to contribute from locations at the same time. The tools available include chat, desktop videoconferencing and GroupWare. Although these online techniques are probably the most similar to face to face teaching., it cannot be assumed that traditional teaching skills will necessarily transfer successfully or easily. This paper examines some of the potential strategies in the use of synchronous computer-mediated communication in education.

Keywords: synchronous communication techniques, computer mediated communication, education.

1 Introduction

The use of synchronous computer mediated communication in education brings some unique benefits. Small groups of students can be combined to make a viable class or expertise can be made available at different sites. When students are on campus they may be able to contact industry mentors and while on practicum keep in touch with teaching staff.

Travel expenses can be reduced as meetings or classes can take place virtually. There are also some unique problems. The logistics of arranging suitable meeting dates and times with appropriate partners can be daunting. When working in an international setting this is compounded by differences in time zones. Narrow bandwidth and lack of reliability can be major technical hurdle.Perhaps the major problem is that the interaction provided by using expensive technology may simply be the same occasional question. This paper looks at some of the strategies for increasing participation and interactionusing these technologies.

2 Setting the Scene

It is important to structure synchronous sessions in order to gain maximum participation. Components that can be adjusted include group size and type, duration, scheduling and outcome of task. In order to prevent anti-social outbursts it is he helpful to establish and publish rules for good'netiquette'. The moderator needs to model considerate behaviour as well as actively enforce the rules. To ease anxiety and enhance communication it is important to build a climate of trust and safety that encourages collaboration.

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While it is important to generate controversy and promote critical thinking student can easily be offended if their efforts are criticised. To minimise this effect it is useful to encourage students to say something positive at the begin- ing of a critique and to offer suggestions for improvement where appropriate. For example, “Bob, I find your ideas on surrogate motherhood very interesting.However, have you considered the following argument, which would not support your conclusion[1,2]. Students need to be aware that opinions alone are not enough. Responses should be supported by data and argument and more importantly ‘re-examined in light of what others in the online group are thinking[3].

Where contributions include “I do agree” or “I don’t agree” they should be followed [2]. Requiring a deliverable, such as plans, designs, papers, reports, portfolios, as an outcome also helps students avoid simply expressing ideas and opinions[3]. If students never have the opportunity to meet face-to-face, digital photos of the students and teacher can be posted to help establish an online identity or ‘telepresence’. E-seminars One of the best ways for student to understand a topic is to organise and simplify it in order to present to others[2].Students can be given responsibility for researching particular topics and provide an e-lecture, lead an online seminar or contribute questions for discussion or examination based on their research.

3 Guest Lecturers

Communication tools allow access to people working directly in the area of study such asinternational experts or work-place mentors.Students can work collaboratively on projects with others from around the world. These projects may be artificial or based on real-world problems. In some cases, the results can lead to changes of real significance. For example, schools from around the world have been involved in collecting data on ‘acidrain’. The data is later combined and analysed to give scientists a more global picture.Methods such as debates, role-plays and simulations are well suited to both synchronous and asynchronous online environments. They allow students to get a deeper understanding of an issue, position or procedure than they would in a typical lecture or tutorial format. Chat spaces can help create a virtual environment to give online role-play a more authentic feel.

For example, one group used such a system to support a United Nations trade negoti ation exercise. Each ‘country’ was given its own UN chat room where students could chat and make decisions on trade-offs before going to the UN room to negotiate with other countries. In a well-known Australian example Internet based role-play simulations have been used successfully in teaching Middle East politics at Macquarie University for a number of years. Teams from Macquarie interact with teams from universities located around the world. While student develop a strong understanding of the content they also report gaining important diplomacy political skills and experience in seeing issues from other points of view [4].

Simulations can be set up by establishing artificial environments. This does not have to be done solely through computer-conferencing. A range of online resources can be made available to help establish the simulation. Dramatic tension can be established by incrementally releasing information.

Hardware and software resources for the proposed Project Based e-Learning (PBeL) conception based remote laboratory are shown in Figure 1. In addition to the computer modeling and simulation software, the online lecture course will be developed and stored at the server. As the environment could be used in both professional and educational audience, a sophisticated tutorial system must be developed. The online lecture course will cover the following main topics:

(1) Smart and Quasi-Digital Sensors Sate of the Art;
(2) Data Acquisition Methods for Sensor Systems;
(3) Classical, Advanced and Self-Adapted Frequencyto-Digital Conversion Methods;
(4) Digital Sensors and Program-Oriented Conversion Methods;
(5) Smart Sensor Systems;
(6) Sensor Buses, Protocols and Networks;

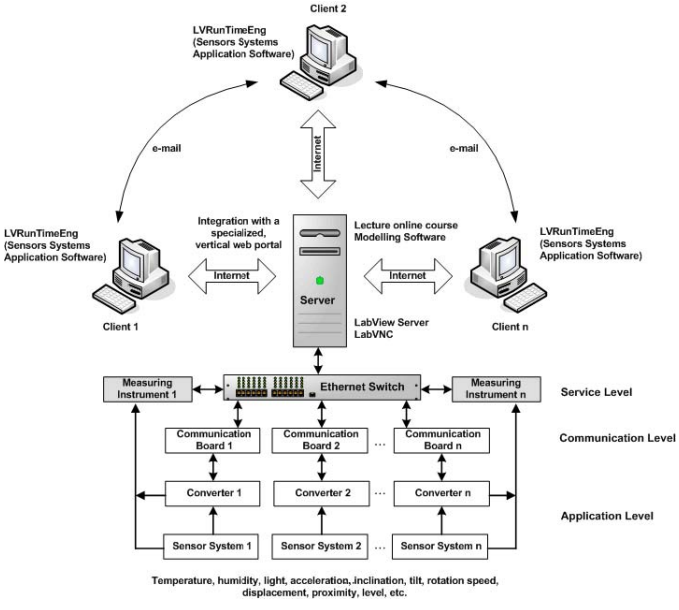

Fig. 1. Project based e-learing conception based remote laboratory

At the end of each course module, after passing the tutorials, a series of tests should be implemented, in order to check the level of knowledge.The LabView server (National Instruments) and LabVNC software will be also run at this server. The server realizes tasks of administration and user authentication; as well it allows learners to interact with the experimental equipments. Clients' computers will run different application software in web browsers.

Remote laboratories are a rapidly growing innovation trend in distance engineering education.The mass proliferation of the Internet, together with the ever-increasing user-friendly computer controlled instrumentation, have favored the development of

such remote laboratories with interactive experiments in the frame of PBeL conception. The remote laboratory's hardware should include standard equipments (Fig.1,)in grey color) such as a server, Ethernet switch or USB-to-LAN Hub, measuring instruments (universal frequency counter, functional generators, oscilloscope, etc.) with LAN communication ports (Service Level); and non standard equipments (in white color) such as universal communication boards with SPI or RS232 to Ethernet bridges (Communication Level) for communication and actuation purposes; and universal sensors and transducers converter and interface boards with connected various sensors systems (temperature, humidity, light, acceleration, inclination, tilt, rotation speed, displacement, proximity, level, etc.) at the Application Level. The possibility to control in a with the help of free LVRunTimeEng. remote way the measuring instruments at the Service.

4 Electronic Office Hours

Students often expect faster response times in an electronic environment with some expecting almost instant answers even on the weekend. Time and date stamping also lead to increased accountability. One study of an online subject found that a major source of student frustration was due to the lack of prompt feedback [1]. One way to deal with unrealistic expectations is to set and advertise 'electronic office hours'. Using syncchronous communication methods these can be maintained from any location wi- th Internet access.

The tendency to use expensive technology to simply replicate lecture presentations needs to be avoided. If a lecture style is necessary, it is recommended that the 'talking head' component be kept short and broken up liberally with graphics presentations, demonstrations and questioning. Teachers who are used to standard videoconferencing facilities report missing the capability of sending slides to remote sites. These can be sent by e-mail in advance or use can be made of a 'shared whiteboard' if available. thedata entered into a GroupWare session can be From different sources for a variety of educational purposes. For example the session might be to brainstorm ideas; organise and classify information; facilitate peer review; identify concepts from assigned readings; generate sugge suggested solutions to a real life problem; make a list of troublesome vocabulary or develop a group dictionary; collect student feedback and questions during a lecture; conduct a simulated (or real) meeting; rank items using electronic voting; collaborate on a piece of writing.

5 Conclusion

Synchronous communication can be used to increase the active engagement of students. However, it is important to note that active learning is more than just pressing keys and reading off the screen. The strategies listed here are just some of the methods that can be employed to increase student engagement. It is recognized that best practice will only develop over time as we share both the successes and the failures of the use of synchronous communication in education.

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The Design of Mobile Web-Based Scientific Research Archives Management System

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Abstract. The rapid development of Mobile Internet services has offered new ways of thinking in scientific research archives management. Based on a thorough analysis of current situations of scientific research archives management and various supports by mobile technologies, the thesis has put forward a design proposal of a complete mobile web-based scientific research archives management system in order to facilitate the management of scientific research archives.

Keywords: mobile web, scientific research archives, management system, design proposal.

1 Mobile Web and Scientific Research Archives

1.1 The Development of Mobile Web

With the maturity and integration of mobile communication and Internet technologies, more and more attention has been paid to the development and application of Mobile Internet. So, what is Mobile Internet? In a broad sense, it refers to the access of the mobile terminal (including mobile phone, PDA, netbook, etc.) to the Internet and its services through the mobile communication network. Due to its unique mobility, personalization and integration, Mobile Internet has been under constant observation of various professionals. Currently, it mainly provides various mobile Internet services, citing web browsing, e-mail, file downloading and uploading, instant messaging, location-based services, and mobile search and community services [1]. As for mobile web, a branch of Mobile Internet, it stands for web service of Mobile Internet. Through mobile phone, PDA, handheld computers and other mobile devices, mobile web has access to contents, applications and services of Internet websites and engages in a lot of data and transaction processing. It is web applications extended from the desktop to mobile devices, thus meeting the mobile users' needs in computers.

1.2 Current Situations of Scientific Research Archives Management

The traditional scientific research archives management is mainly based on manual collective processing of paper or electronic documents. But nowadays, this management

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approach can not guarantee accuracy and timeliness of management process, nor can it meet cross-boundary telecommuting demands [2]. As follows are major deficiencies of current scientific research archives management:

1) Inadequate supervision of the project
Due to temporal and spatial reasons, the research project manager, who is faced with so many projects, has difficulty in obtaining the latest information of the research process, thus real-time monitoring cannot be guaranteed. It is quite reasonable that a number of researchers tend to focus only on project application and neglect the research itself. Researchers tend to focus only on project application while overlook the research itself. This phenomenon has led to some false data, empty experiences and even nonexistent scientific achievements of projects, which have a very bad effect on scientific research [3].

2) Inefficiency of research
In doing scientific research, painstaking efforts are made to declare the project, conduct research, do periodic review and make concluding identification. In the traditional scientific research archives management, frequent data exchange and large data volume have not only disabled it to achieve good communication, data sharing, streamlining work procedures, but also led to errors of information transmission, ending up retarding the research and greatly increasing the management costs [3].

3) Ineffective communication and cooperation of task-force
To complete a project, joint efforts within the working group formed by multiple units will play a key role. Enough communication, information sharing and cooperative work ——all these factors will be in desperate need. On the contrary, due to spatial distance and decentralized management, research group members are lacking in effective mutual communication and effective cooperation.

4) Difficulties in resourcing and reuse of data
When doing educational research, the progressive and conclusive files, the relevant resources and records of members' communication are valuable materials. But the current status of archives management is that these data are scattered, messy and even lost, posing a great obstacle to resourcing and reuse of data.

1.3 Supports by Mobile Web for Scientific Research Archives Management

With the increased bandwidth of mobile networks and rapid development of Mobile Internet, a wide variety of researches of mobile web services are gradually increasing. Currently, the traditional scientific research archives management has failed to meet the needs of people, and this web platform for scientific research archives management thorough mobile devices has become a trend. Supports by mobile web for scientific research archives management are shown in the following five areas:

1) Mobility [4]
Through the ubiquitous high-speed wireless Internet Network and WLAN, users can be free of temporal and spatial constraints and accessible to a wealth of information whenever and wherever possible. What is more, the application range of the system has been expanded, in the sense that the research project manager has real-time access to the latest progress made in researches and reacts to it accordingly.

2) Efficiency
PC users tend to use mobile devices more frequently. Real-time data transmission and processing greatly reduce the inconvenience of information delay and promotes more effective communication between the research project manager and participants. And also, the realization of dynamic management shortens the decision-making period.

3) Pertinence
Mobile web can provide personalized services for professionals of different authorities in various groups. Relying on a database of enormous personal information to develop targeted information dissemination and reminder systems, mobile web can operate the personalized and differentiable management of various projects and personal staff.

4) Sharing
Mobile web can provide users with instant messaging, mobile email, mobile blog and other synchronous and asynchronous information exchange services. Researchers may make full use of system services to facilitate the information exchange, thus greatly improving information sharing among researchers.

5) Security
Mobile devices are proprietary equipment of high privacy and are permissible only to their users. Meanwhile, the one-to-one correspondence of two kinds of users——Mobile Internet and mobile service ones——is helpful in exclusive identification of users. Once users operate on the system through personal mobile devices, effective client authentication will function well and prevent malicious tampering with document from other users, therefore improving the security of the system to a large extent.

2 Functional Design of Mobile Web-Based Scientific Research Archives Management System

Mobile web-based scientific research archives management system will be the developing trend of archives management in the future. Therefore, it is necessary to build a scientific research archives management system which is fully functional and easy to use, what's more, which has the advantages of real-time property, great flexibility and much interactivity. The design of such a system involves a number of factors including real-time process management, convenient information query, real-time system alerts, synchronous and asynchronous communications and etc. In my opinion, mobile web-based scientific research archives management system has the following prominent features:

2.1 Capabilities of Providing Real-Time Process Management

The system will help to establish project assessment expert groups in related fields, and accordingly send members the panel data of research projects. Experts can download and view the contents of the reported issues via the handheld devices, just as they receive multimedia messages, and then submit their suggestions and decisions to the decision-making module. Later the system will send experts' feedback timely to

those researchers and inform them of results. As for materials produced in this stage, it will be automatically saved to the corresponding scientific research documents. Automatic transition to the new phase of research after this period of work will make the real-time management possible.

2.2 Function of Real-Time and Convenient Information Query

As research goes further, numerous data will be accumulated in the system, which makes real-time and convenient information query essential[5]. Comprehensiveness and convenience should be pursuit in the functional design of information query. On one hand, all relevant information, such as project information, application materials, related contracts, research group and personnel information, research status, use of funds, research achievements, experts' feedback, records of group discussion and etc, should be contained in the system. On the other hand, as for modalities in information query, two ways, search engine retrieval and database searching, should be available. In addition, considering the large volumes of data and query complexity, we use a common query method; that is to say, all field names are retrieved from the database, allowing users to select the query fields and operating conditions. Then based on the given query conditions, the system returns to the operating results and inform its users by outputting the report form.

2.3 Synchronous and Asynchronous Information and Blog Services

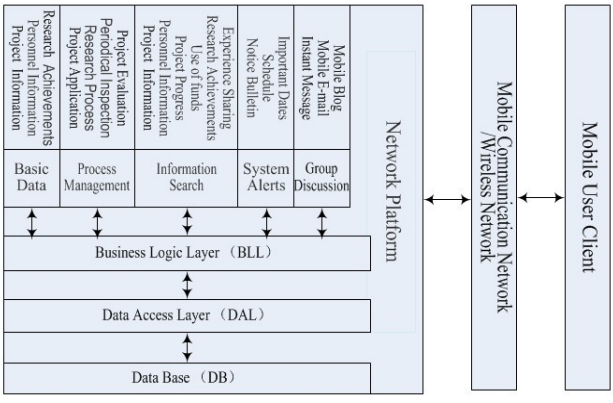
The system provides users with a variety of network-based communication, for example, instant messaging, e-mail services, mobile blog and other electronic means of communication. Mobile instant messaging is a kind of synchronous communications between mobile users, providing real-time services such as sending text and picture messages. What needs clarifying is that not only can mobile instant messaging users be able to communicate with each other in a one-to-one manner, but also be accessible to mutual exchange of opinions within the research group. Meanwhile, mail service is a way of asynchronous communications in information services. Through mobile e-mail, users can receive, view, edit, and send the message whenever and wherever possible. In addition, characteristics of the system, simple operation, quick delivery, easy storey and global availability, have helped solve the problem of information loss. As for later developed mobile blog service, it provides researchers with private space where they can manage according to their will as long as they have the accounts and passwords. Users can also express their views on issues and allow other users to browse and copy the blogs. In this way, mutual communication between team members is promoted.

2.4 Personalized Information Alerts

In the research, the system will remind its users of important dates and research assignment, enforcement and inspection to ensure that users can complete tasks on time, thus greatly enhancing the execution of research projects. Information alerts acts like a personal secretary. By reminding its users of scheduled tasks at a certain time, it helps researchers to concentrate on creative activities [5].

3 Structural Design of Mobile Web-Based Scientific Research Archives Management System

Based on the structure model of mobile-web design and specific functions of scientific research archives management system, I put forward a design proposal of mobile web-based scientific research archives management system, whose overall structure will be shown in Graph 1:



Graph 1. The structure of mobile web-based scientific research archives management system

Mobile web-based scientific research archives management system consists of the mobile user client, mobile communication or wireless networks and a network platform based on the three-layer architecture (UI, BLL, and DAL) [6].

3.1 The Mobile User Client

The client mentioned here refers to the mobile terminal, which, with such support equipment as mobile phone, PDA and other mobile devices, acts as the interactive media between the user and the system by presenting its contents to the user. So the system can offer three different types of personalized functions and services to the researchers, the research director, and project manager.

3.2 The Mobile Communication or Wireless Network

By using mobile terminal, users communicate with the network platform through the mobile communication networks or wireless network. Wireless network can be either a number of institutional private networks or public ones provided by network operators. As long as the wireless access or mobile connecting are available and a certain bandwidth on the line can be achieved, users will be able to communicate to the operating system.

3.3 A Network Platform Based on the Three-Layer Architecture

The platform, the core of the system, stores all the data, provides various services and supports terminal services. It can be divided into Presentation Layer, Business Logic Layer and Data Access Layer. Presentation layer, which is located in the outermost layer (top), can display information, receive users' input data, and in turn provide users with an interactive operation interface. Business Logic Layer reflects the core values of the system. It is mainly concentrated in making the business rules, implementing the operational procedures and creating systematic designs related to the business, or we can put it in this way: it is the system that is coping with the domain logic. Data Access Layer is also known as the persistene layer, whose main function is to be in charge of database access. With this layer, users can be accessible to the database system, binary files, text documents or XML documents.

In order to meet the needs of mobile archives management, the platform has established five modules: basic data, process management, information query, system alerts and group discussion.

1) Basic data module:
This module is designed to archive and preserve related scientific research information and to provide different users with personalized services, for example, accessing, adding, deleting, and modifying the base data, which includes research information, personnel information and research achievements. Research information refers to the subject of the research along with application materials, contracts, project schedules, use of funds, inspection reports and other information. Personnel information mainly refers to members' basic information, their authorities in research, their respective groups, assignments and etc. Research achievements include initial progress, ultimate outcome and experience sharing.

2) Process management module:
This module is to provide real-time management services, such as automatical track and dynamic transactions in each period, which includes the application stage, research process, periodic inspection, and project evaluation. And service of report is also available. It records project progress, reports completed and undone assignments, and offers expert advice timely for the merging problem Meantime, dynamic transaction processing is to deal with issues required in different stages, citing research application, evaluation and other matters.

3) Information query module:
This module is to provide users with real-time access to the applied, conducted and complete projects. Not only can it output research information, personnel information, project progress, use of funds, project outcomes (initial progress, ultimate outcome), valuable experience sharing and other information, but also due to its wealth of data query functions, the module can distribute various levels of authorities to users and allow them to obtain all information within the purview of their own data.

4) System alerts module:
This module can offer intelligent alerts service in users' research. Bulletins, undone tasks, important dates will be sent to mobile user terminals in short messages, thus

obtainable to different users. After receiving the messages, users can reply to system they had received the messages. In a word, the module is a personalized intelligent reminder.

5) Group discussion module:
This module is mainly to provide users with synchronous and asynchronous communication and exchange service. With instant messaging communication tools, asynchronous mobile email services, and mobile blog function.

4 Conclusion

Currently, mobile web-based system has spearheaded a simple application in the medical and coal industries. For example, mobile clinical information system to inspect patients' conditions [7] and mobile operating room nursing information management system [8] have been brought into operations while mobile security information management systems are developed [9]. But such applications are clearly insufficient in the management of educational and scientific research. In this thesis, mobile web-based scientific research archives management system is explored in order to put forward a new method of project management, thus improving the quality and efficiency of scientific research. Although web-based technology is not sufficiently mature, nor is scientific research archives management program perfect, with the development and application of mobile technology, mobile web technology is sure to have a profound impact on research archives management.

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Research on Content Design of Teachers' Online Training Courses Based on SCORM

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Abstract. With deep application of computers and network technology, online training courses gradually become an important way for training teachers. Many researchers paid much attention on these courses and studied their characteristics of sharability and reusability. This paper suggests applying SCORM in content design of teachers' online training courses, which is a very popular standard with targets at sharability and reusability in digital learning field. Basing on the instructional design model ADDIE, it puts forward a model on design of teachers' online training courses and describes every step especially on how to apply SCORM standard into the content design and development of the training courses. It is expected to provide a reference for the design and development of online training courses for teachers, realize the communication and resource share among different courses, and promote integrative development of digital resources.

Keywords: SCORM, teachers training, online course, content design, instruction design.

1 Introduction

As an efficient approach to enhance teacher quality, teacher training will last through a teacher's whole carrier life. In June, 2010, China's Ministry of Education and Finance issued a joint circular about carrying out "the national-level program of primary and secondary teacher training", which is scheduled to be carried out in 2010 [1]. In this program, much importance is given to long-distance teacher training, the development and integrity of training resources by the educational world, and online training courses are blooming, too. Comparing with traditional training courses, online courses are trainees-centered, have self-scheduled training progress and contents, extended training time, multiple training forms, timely update of training resources and exchange, and easy communication. Therefore, online training courses

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are being widely used in training sector. However, there are not unified codes and standards for online training courses at present, which is not favorable to the universality and expandability of different online training course platforms [2]. Luckily, SCORM (**Sharable Content Object Reference Model**) is a universal reference model standard, and it specifies how to classify, save and present learning content objects. With SCORM followed, it amounts to that different online training courses share a common language, so they can easily exchange with each other at low cost in a short period and share training courses and resources, thus saving a mass of personnel, material and finance resources. In short, SCORM is an effective approach to reach the integrity and sharing of online training resources.

2 A Model on Course Design of Teachers' Online Training Based on SCORM

2.1 SCORM

SCORM is a specification of the Advanced Distributed Learning (ADL) Initiative, which comes out of the Office of the United States Secretary of Defense [3]. SCORM is a set of technical standards for e-learning software products. SCORM tells programmers how to write their code so that it can "play well" with other e-learning software. Specifically, SCORM governs how online learning content and Learning Management Systems (LMS) communicate with each other. SCORM does not speak to instructional design or any other pedagogical concern, and it is purely a technical standard [4].

SCORM 2004 is the latest version of the SCORM, consisting of a Web-based learning Content Aggregation Model (CAM), Run-Time Environment (RTE) and Sequencing and Navigation behavior for learning objects [5]. The standard uses XML, and it is based on the results of work done by AICC, IMS Global, IEEE, and Ariadne. If educational material is created according to the SCORM 2004 model, a SCORM 2004 compliant RTE will be able to 'play' the material and the expected run-time behavior will result. The SCORM 2004 requirements on the content cover not only its structure and packaging but also requirements on implementing run-time behavior so that communication between a running Shareable Content Object (SCOs) and an associated Learning Management System (LMS) is facilitated [6].SCORM is composed of three sub-specifications as follows [7].

1) Content Packaging section: It specifies how content should be packaged and described. It is based primarily on XML.

2) Run-Time section: It specifies how content should be launched and how it communicates with the LMS. It is based primarily on ECMAScript (JavaScript). As shown in Fig. 1 [8].

3) Sequencing section: It specifies how the learner can navigate between parts of the course (SCOs). It is defined by a set of rules and attributes written in XML.

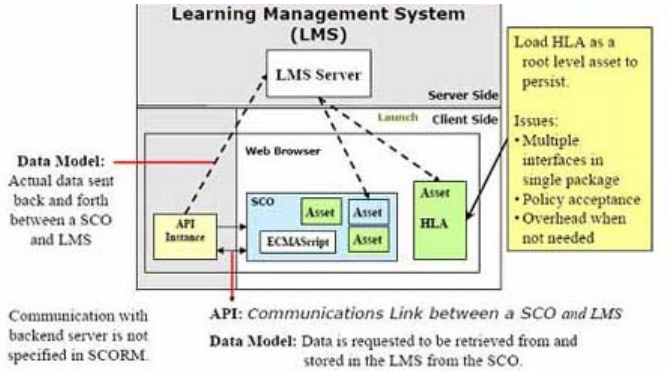
Learning Management System (LMS)
LMS Server
Server Side
Launch
Client Side
Load HLA as a root level asset to persist.
Issues:
• Multiple interfaces in single package
• Policy acceptance
• Overhead when not needed
Data Model: Actual data sent back and forth between a SCO and LMS
Web Browser
API Instance
SCO
Asset
Asset
ECMAScript
Asset
Asset
HLA
Communication with backend server is not specified in SCORM.
API: Communications Link between a SCO and LMS
Data Model: Data is requested to be retrieved from and stored in the LMS from the SCO.

Fig. 1. Run-time environment of SCORM

2.2 ADDIE Model

The Instruction Design of course contents is indispensable in the process of course development. Because course contents are ultimately taken by learners, we must carry on the design which can be more effectively spread the knowledge to learners. The basic process of Instruction Design includes Analysis, Design, Development, Implement and Evaluation. And it's referred to as the ADDIE Model.

First of all, developers analyze the trainee demand and understand the key points and difficulties of training content. Training purpose is to solve the problem. According this to analyze, new knowledge gotten by teachers in the training can be directly used for classroom teaching. In teacher training, it is improving teaching quality, significantly, the teachers' enthusiasm and training effect. Secondly, based on the analysis, developers design a generation details or plans of training materials, and then make the training content materials according to the design. SCORM will be used the content development. Design of content in the training course according to the SCORM can be divided into Assets Development, SCOs Development, Meta-data Compile, Embedded Sequencing Code and Course Content Packaging etc. Finally, developers implement and evaluate the training course.

2.3 Construction of the Model

We integrate the SCORM and ADDIE into the content design of teachers' online training to construct a model, in order to give full play to the role of SCORM and the features of ADDIE in the Course Design, as shown in Fig. 2.

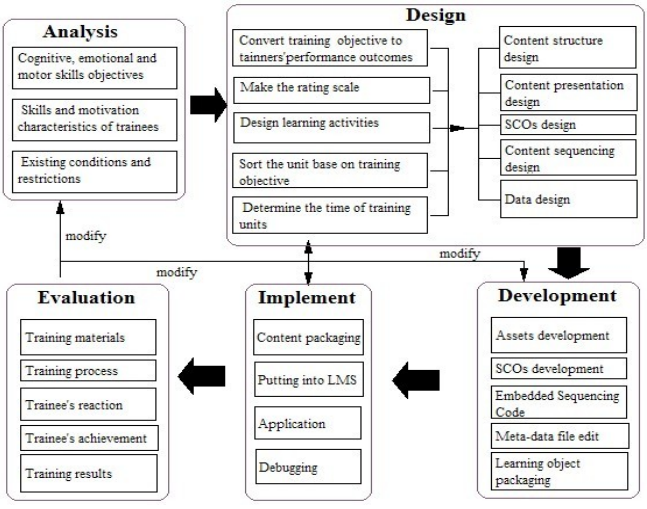

Fig. 2. A model on course design for teachers' online training based on SCORM

3 Instruction Design Process of Teachers' Online Training Courses Based on SCORM

3.1 Analysis

According to the demand analysis and planning in the teacher training, we determine what are used for training, and the most important thing is to analyze the training content. The analysis is from three aspects, one is analyze cognitive, emotional and motor skills objectives; second is to analyze the skills and motivation characteristics of trainees; third is to analyze existing conditions and restrictions.

The content of teacher training includes theoretical knowledge, skills knowledge, and attitude. The purpose of training theoretical knowledge is to enable teachers to have the necessary teaching subject knowledge, teaching theory general, new educational concepts. The knowledge learned in education degree is only to review, summary, and new knowledge and teaching idea is the focus of training. The training purpose of skills knowledge is to enable teachers to master the effective teaching methods and strategies in the teaching process, such as successful teaching cases, strategies of applying principle rules in specific cases. In addition, the training of teacher attitude is also very important. Teachers with a passion for education are likely to become a good teacher, especially for teachers in primary and secondary schools. The aim of attitude training is to enable teachers to have a sense of responsibility, love, patience and good psychological quality, and to establish a good teacher-student relationship with students.

3.2 Design

According to the purpose of the training content, we use SCORM to refine and design the content, for the purpose of the development. If training is for teachers in primary

and secondary schools, trainer should pay attention to load in working and learning. The load would be very heavy. Each class should not be too long, controlling in 15-20 minutes.

1) Content Structure Design: To ensure that every learning object has a clear integrity theme and objectives, content structure designed using object-oriented design, that according to the learning objects, we determine the explanation, content, practice and evaluation of learning object and its content structure. The focus is the content structure of learning objects, which we determine content items of the composition of learning object. We took content structure of SCORM as an example. As shown in Table I.

2) Content presentation design: Overall, content presentation design is that the page should be simple and friendly, logical, reasonable structure. The key is to be simple, concise presentation is easy to focus. Therefore, the screen should try to remove useless background and extra details. In order to avoid the online course content takes too much space and the complicated packaging, we should try to avoid image modification, and are best to use style.

3) SCOs Design: SCOs design is the basic unit and the core part of content design of the training course. It includes designing the size and interaction of SCOs granularity. The size of SCOs granularity is greater flexibility. It can be the chapter, section, unit of the course and it can be any size. It is very important to emphasize that SCOs must contain at least one training objective which must be a unit that can be recorded.

Table 1. Content structure of SCORM

Content	Content Branch			Level
Introduction of ADL and SCORM	Summary of ADL			Understanding
	Basic concept of SCORM			Understanding
Production process of SCORM	Rules of SCORM			Understanding
	Evolution of SCORM			Understanding
High-level requirements of ADL	High-level requirements of ADL			Understanding
Characteristic and content of SCORM	Component of SCORM	CAM	Content Model	Comprehension
			Meta-data	Grasp
			Content Packaging	Grasp
		RTE	Launch, API	Grasp
		SN	SDM, SB, NM	Grasp

4) Content Sequencing Design: Content sequencing design is to design and lay out the order of the content presentation. We will integrate teaching strategies of trainer into the content sequencing process to meet the different demands of trainees and reach the purposes of personalized training.

5) Data Design: Meta-data in SCORM including the Assets Meta-data, SCOs Meta-data, Learning Activities Meta-data, Content Organization (CO) Meta-data and

Content Aggregation (CA) Meta-data. When designing the Meta-data, we can refer to the nine categories of Meta-data elements and their application that SCORM defined. Including "M" is mandatory, "O" is optional, and "NP" is not option.

3.3 Development

Development is to achieve the design of course and applies to teachers' online training platform.

1) Assets Development: Assets are the most basic form of Learning Resources. They are presented to the trainees in the electronic form of multimedia resources, including text, images, sound, appraisal document, etc. The multimedia resources can use the software tools (such as Dreamweaver, Flash, Photoshop, etc.) to develop.

2) SCOs Development: SCOs are an asset or collection of assets. The main job of SCOs development is to embed the interactive code based on the assets. Embedded API code refers to three categories of functions of API provided by the SCORM RTE and their syntax. Definition and usage of data model element can refer to data model of SCORM RTE.

3) Embedded sequencing code: Embedded sequencing code is to write code to implement the specific requirements of the order of content presentation according to the design of content Sequencing. Definition and usage of element can refer to Sequencing and Presentation in SCORM CAM and Sequencing Definition Model in SCORM SN. It can use the software tools to complete, such as the Reload Editor.

4) Meta-data Edit: Meta-data edit is writing the Meta-data XML documents for Assets, SCOs, CO and CA. We can use XML file editor tool to write these Meta-data documents, such as notepad, XMLspy and so on. But if there are much Meta-data needed edited, it will be a very heavy work. We can also use some related software to edit these Meta-data documents, such as Reload Editor, LAN 3.0 guestbook and so on.

5) Learning Object Packaging: Learning object packaging, we can use the software which named "Reload Editor" to achieve, is to build a content manifest file and a package interchange file for learning object. With the packaging, we can just appoint the location of meta-data file in the manifest file and put the meta-data file in the correspondingly Components' catalog. What need to point out is that we don's have to compress the package into a package interchange file. In addition, we also can publish it using CD or other moving media directly. But for the convenience of transport on line, we compress it into zip, jar or cab format.

3.4 Implement and Evaluation

The implementing is to put training contents which trainee need on the training platform and includes content packaging, testing, importing and implication. Evaluation includes evaluation of training materials, evaluation of training process, evaluation of trainee's reaction, evaluation of trainee's achievement, evaluation of training results. On the basis of these evaluations, we can revise course content in term of analysis and design, development and application, so that we can make training reach to the highest standards.

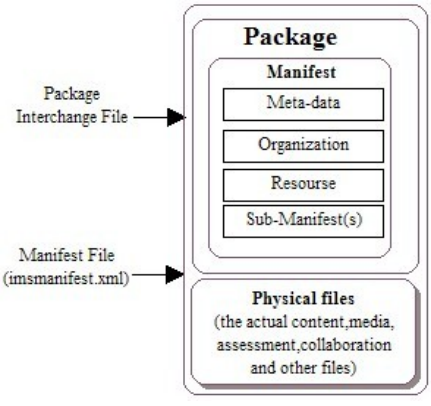

Fig. 3. Learning object packaging

4 Conclusion

Teacher online training platform provides an online supporting learning environment for teacher. Teacher can always participate in the network training and not limit by time and place, and professional knowledge and skills are promoted. Teacher training network platform is popular with all teachers. This paper discussed SCORM application in the online training platform development. The SCORM operation-al is very strong and provides reference meaning for design and implement of online training platform. Followed SCORM, different online training platform achieves the sharing of learning tools and resources and course content integrated organically, and avoids duplication development of digital resources and money wasting.

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Research on Strategies of Digital Resources Construction in Teachers' Distance Training for Primary and Secondary School

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Abstract. With the development of the basic education curriculum reform and information teaching, the distance training, which helps improve teachers' professional skills, becomes an effective way for primary and secondary school teachers to accept continuing education. Analysis on achievements in the digital resources construction will be showed in this paper, in which problems are also indicated such as policy flaw, inadequate fund, resources shortage, the lack of unified standard and balanced development, etc. Additionally, series of construction strategies for digital resources of distance training will also be demonstrated in the article including overall planning, policy guiding, advocating sustainable development, emphasizing on high quality resources construction and unifying standard and criterion.

Keywords: primary and secondary school teachers, distance training, digital resources; strategy research.

1 Introduction

Due to the increasing development of basic education curriculum reform and information teaching, primary and secondary school teachers are much lacked of professional skills and information literacy. Thus, "Primary & Secondary Teachers Distance Training" was proposed by the educational administrations aiming to improve teachers' overall ability to fit the new changes.

Recently, a notification about Implementing a State-level Training Project for Primary and Secondary School Teachers was issued by education ministry and finance ministry, deciding to start the project in 2010, which is an important exemplary measure to improve the quality of primary and secondary schools teachers, especially those in rural areas. It is also clearly indicated that the project contains Exemplary Training for Primary & Secondary School Teachers and Training for Backbone Teachers from the central and western rural areas. Furthermore, the Exemplary Training for Primary & Secondary School Teachers contains trainings for primary and secondary school backbone teachers, head teachers, primary and

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secondary school teachers in rare and weak subjects, as well as the distance training for primary and secondary school teachers.

However, the most important thing for distance training is to enhance its digital resources construction, which will contribute a lot to facilitating the share of high quality resources. It is also for the purpose of meeting the need of information of continuing education, reforming the continuing education pattern and enhancing efficiency.

2 Analysis on Current Situation of Digital Resources Construction for Primary & Secondary School Teachers in Distance Training

Digital resources construction plays an important part in the distance training for primary and secondary school teachers. In recent years, to coordinate with the promotion of the basic educational information and the implementation of modern distance education in rural primary and secondary schools, lots of work has been done by education administrations, schools and enterprises. And now impressive progresses have been made whether in quantity, media variety, transmission mode, or even in the member of developing digital resources construction and the quality of the work. However, success has been achieved but problems also arise at the same time.

A. Progresses

1) Increasing Popularity in Distance Training Platform: Various distance training platforms have been built presently, such as Primary & Secondary Teacher Continuing Education Net and Basic Education Resources Net, together with province-level training platforms, For example, by the end of May 2009, the State Primary & Secondary School Teachers Continuing Education Net, which had been carrying out 7 state-level training programs and 35 province-level training programs, had built up 18 province-level terminals. It had over 600 regional learning & resources centers for teachers and over 60 local special websites. Furthermore, with the organizational management of county-level training agencies, nearly 100,000 primary and secondary schools had carried out school-based distance training for total 2 million teachers with the use of the continuing education net.

2) Enrichment in Digital Resources: The rich education and extended resources somehow help improve the quality of the distance training for primary and secondary school teachers. Moreover, all the contents meet the requirements of scientificity, integrity and advancement. Consequently, the resources are widely accepted by teachers for it largely improving their professional skills.

B. The Existing Problems

1) Lack of Efficient Guidance: The long-standing situation of low level repeatable development of the training resources may attribute mainly to education administrations' relevant policies flaw, insufficiency in specific coordination and guidance. Meanwhile, the importance of distance training is still not recognized by many education authorities and teachers. They simply complete the construction of resources platform according to regulation of files, but lack emphasis on detail work. So, the reality is that: on the one hand, resources is of great shortage in distance

training for primary and secondary school teachers, especially the high quality resources with academic value and strong guidance, as well as those of great theoretical and practical value. On the other hand, a great many of resources, including the excellent teachers, educational institutions and human resources, are laid idle in education technology departments

Moreover, basic education departments are not strong enough to build up relevant resources and are eager for some expert advice both on theory and practice.

2) Lack of Financial Guarantee: Nowadays the investment for the construction of digital resources is still insufficient, especially for most rural areas in undeveloped regions. And the great need for various resources constructions cannot be satisfied by simply relying on the investment from education administrations. However, the distance training, involving with quality education and the construction of teachers group, is a systematic project. Though lots of resources and platforms for distance training are built, many provinces are lack of long-term effective investment. They focus only on disposable exploitation instead of sustainable investment based on original resources and platforms.

3) Shortage for High Quality Resources: There is a great shortage in high quality resources that can meet the requirements of the curriculum reform, IT environment features and the need for quality and moral education. What schools and teachers concerned most is that the existing resources have prominent problems in aspect of systematicness, supporting textbooks, etc. Additionally, more problems are listed as follows: firstly, the lack of pertinence in the learning guidance has caused the ignorance of trainees' individual learning needs; secondly, teaching cases, desired among those teachers, are deficient; thirdly, most digital resources have problems such as little interaction, the lack of remedial assessment, inadequate discussion, as well as unspecified and delayed feedbacks; fourthly, the form of resources contents are lack of variety while the training contents are lack of variety and contextualization. Lastly, the resources do not take advantages of multi-media but being improperly used by media.

4) Lack of Unified Technical Standard: The lack of a unified technical standard may be the main reason for the constraint on resources share. With various technical standards, many local education authorities develop resource database platforms using their own system, which leads to repeatable construction of resources platforms as well as large inconvenience in retrieval and share. Nowadays in many provinces, most distance training resources based on local area network (LAN) are generally built for teachers in administrative regions. Nevertheless, share of resources cannot be made between different provinces, and that somehow causes "information islands" that are unable to satisfy teachers' individual needs because of the lack of variety in resources.

5) Obvious Imbalance: Though the importance of digital resources construction for distance training has been widely recognized by many administrations and schools, region imbalance is still conspicuous due to different histories and imbalanced economy development. As a result, the constructions of digital resources in rural areas and undeveloped provinces are rather backward. Without physical environment of digital resources application and awareness of digital resources construction, some teachers become less positive using digital resources in distance training.

Likewise, the imbalance of digital resources construction also shows in different learning stages. The construction of digital resources in primary schools is apparently better than middle schools and high schools. And with less pressure to help students enter middle schools, primary school teachers can focus more on developing and applying digital resources. Furthermore, multi-media effects of the digital resources, which integrate text with pictures, are much better for presentation of primary subjects. Thus, the construction of digital resources database in primary schools is more abundant and practical.

It is necessary that directors and resources constructors pay attention to above problems and take efficient measures to make a better situation, only by which can the digital resources construction continue efficiently to improve the training for primary and secondary school teachers, as well as resources utilization rate.

3 Strategies of Digital Resources Construction for Primary and Secondary School Teachers in Distance Training

In terms of development, whether the success and problems can be treated objectively by the government, education administrations, schools and teachers will influence the distance training a lot in both its effects and quality. And in my view, construction strategies should be given special consideration as follows on the basis of China reality.

A. Overall Planning and Policy Guidance

Education administrations, schools and relevant authorities should be aware of the correct view of the resources and lead resources construction positively. Distance training resources are suggested to be built not only on the needs for quality education and curricular reform, but also aiming to fit the increasing development of IT and network technology. Additionally, with principal parts of primary and secondary school teachers, it is important to build up high quality education resources for them and integrate individual development with scientificity, systematicity, authority, alternative and openness. In addition, a resources pattern based on platforms and equipments should be set up for connection and communication. Meanwhile, with the purpose of application, connection and communication, the relevant authorities should support greatly for the equipment development of learning context creation, knowledge construction, scientific research and social cooperation, which will contribute to the development of resources construction. Lastly, it's necessary to set up the correct guideline and improve teachers' self-learning ability and positivity in the training.

B. Advocating Sustainable Development

Two points for sustainable development of the digital resources construction are listed as follows: Firstly, to assure that the construction is progressing sustainably instead of a disposable one; Secondly, to realize that the use of the resources is sustainable under certain mechanisms protection and not in a short time. Besides, two sub-mechanisms are contained in the protection mechanism. One is the management mechanism including construction of leading agencies and system, and the other is operation

mechanism including planning mechanism, incentive mechanism, sharing and updating mechanism, etc.

The distance training for primary & secondary schools teachers, a systematical project involving teacher group construction and quality education should be highly attached great importance by the government and education management departments. It's not only a highly efficient and economical way to develop continuing training for primary & secondary school teachers through Internet, but also a learning way accepted by them. Thus, support is expected from the government and education management departments and relevant policies protection should be set up to assure a sequential construction. Meanwhile, with wide involved fields, large investment and advanced technology, the construction requires a unifying construction program and relevant mechanisms from education management departments to assure the sustainable investment.

C. Attaching Great Importance to High Quality Resources Construction

To meet the needs of the distance training for primary and secondary school teachers, it's necessary to take advantage of forces widely from all sectors to set up high quality resources associated with curriculum reform and new courses. Furthermore, the emphasis is to establish education resources of high quality, which covers main courses and teaching forms. More than that, local special resources and language resources construction among ethnic minorities should be enhanced. And to serve all primary and school teachers without charging, it's vital to set up a platform for interaction. Lastly, a high quality resources construction of distance training should be committed to the principle of variety, practicality and goal-orientation.

1) The Principle of Variety: It means that all contents of the resources should be helpful to improve teachers' professional knowledge and psychological quality, to enhance their knowledge and skills as well as their teaching and research ability. Besides, contextual and diverse design of learning activity, together with teaching contents design especially for teaching cases, should be more focused on the specific learning contents. It's additionally important to give feedbacks to questions from trainees during training.

2) The Principle of Practicality: That means to pursue practical effects during resources construction and make full use of the advancement and efficiency of network education. Construction is not the final goal and only when used in distance training can it make a difference. In addition, the resources construction and programming of distance training, based on practical needs, ought to serve all primary and secondary school teachers. It's also important to focus on demand analysis of end users and develop relevant resources. The last point is to mobilize teachers' initiatives into distance training and improve resources utilization.

3) The Principle of Goal-Orientation: Firstly, set up learning objectives on the basis of practical education in primary and secondary schools. And secondly, increase resources quality, quantities and contents to fit the changeable education environment. Thirdly, the resources construction must be pertinent, which requires pertinent contents to teachers' needs, pertinent organization form to teachers' learning features, pertinent learning way to teachers' practical position features and pertinent quantity and quality to meet the teachers' practical needs

D. Unifying Standard and Criterion

Resources construction of distance training should be promoted in standardization, which means to gradually form a certain pattern in the construction to achieve resources share with unifying standards and methods used by those different constructors. That will improve constructors' efficiency while providing convenience for end users. To set up a resources standard, great importance should be attached on the share of various platforms to make a firm foundation for sustainable development of resources.

Moreover, more emphasis should be put on the openness and the share in the standardized construction of resources for distance training, which is helpful to break the regional imbalance and provide high quality resources for teachers in rural areas and undeveloped regions. This will help improve teachers' quality together with skills while increasing resources utilization rate.

4 Conclusion

In conclusion, distance training for primary and secondary school teachers is playing an important role in teachers' continuing education and profession development. However, the focus of training digital resources has also been transferred to a phrase of "applying knowledge to practice" and "improving abilities efficiently". Requirement is increased on the quality and personality of the digital resources. Thus, it's vital for to explore high quality digital resources following distance learning rules and various patterns, which assures the training quality while improving it. Last but not the least, relevant authorities should focus more on integrating features of modern distance training, so as to promote high quality digital resources construction of distance training.

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Output Promoting Students' Noticing and Acquisition of English Passive Voice

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Abstract. In this paper, the author conducted an experiment to examine the effectiveness of text reconstruction. The author introduced the experiment data into the formula: $|Z|=|(\mu-\mu_0)/(\sigma_0/\sqrt{n})|$. Based on calculation, the author found that the subjects of experimental group show greater noticing and better acquisition of English passive voice than those of control group. The present study overcame the shortcomings of the prior experimental studies. Previous researchers always choose the past hypothetical conditional in English as the target form. Also their experimental subjects are always the foreign English language learners or high school students. The present study took English passive voice as the target form and took Chinese college English learners as experimental subjects. The findings not only provide some support for the noticing function but also bring some implications for Chinese College English teaching.

Keywords: noticing function, experimental study, English passive voice.

1 Theoretical Background

1.1 Noticing Function of Output

Output is defined by analogy in Longman Dictionary of Language Teaching & Applied Linguistics. Input refers to "(in language learning) language which a learner hears or receives and from which he or she can learn" [1]. By analogy output refers to "the language a learner produces" [1]. In this case, output means the language a learner produces compared with what the learner receives.

It has been argued that "output is nothing more than a sign of second language acquisition that has already taken place, and that output serves no useful role in SLA except possibly as one source of input to the learner" [2]. And as a result, the role of output in second language acquisition has been ignored over a long period. This situation has changed with the emergence of some researches and studies of the output theory. Among these, Swain's Comprehensible Output Hypothesis is the most systematic and persuasive. Swain's interest in the role that output plays in second language acquisition evolved from her study of Canada's French immersion programs. In such immersion programs, non-French speaking children were placed as early as kindergarten into school classes where French was the sole language for teaching. They were immersed in French and were thus provided with what would

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seem to be a nearly ideal language environment, which seemed to have rich input for their acquisition. Surprisingly, these students' French was still off target after a fairly long period of acquisition. After intensive study of these immersion programs, in 1985 Swain proposed a hypothesis relating to the role of second language learners' production of the target language and she termed it as the Comprehensible Output Hypothesis. The hypothesis claims that producing the target language, especially when learners experience difficulties in communicating and transmitting their intended messages successfully, can push learners to make their output more precise, coherent, and appropriate. Since the Comprehensible Output Hypothesis was proposed, Swain has refined her hypothesis and specified functions of output that provide strong support for the fact that output can promote second language acquisition. The functions of output refer to "1) the noticing function, or what might be referred to as its consciousness-raising role, 2) the hypothesis-testing function, 3) the metalinguistic function or what might be referred to as its reflective role" [3].

Among the three functions the present thesis focuses on the noticing function. By the noticing function, Swain means "when learners produce their target language to meet certain communicative goals, they will find that there are some linguistic problems, which may hinder the producing, even communication" [3]. That is to say, producing the target language, learners may notice the gap between what they want to convey and what they can convey, leading them to recognize what they do not know or know only partially about the target language. This process of noticing activates cognitive processes that generate linguistic knowledge that is new for learners or consolidate their existing knowledge. In other words, producing the target language prompts learners to consciously recognize some of their linguistic problems and pay more attention to the linguistic features of their own production and of relevant language input so that their intended meaning can be better conveyed.

1.2 Prior Experimental Studies and Limitations

Since the Output Hypothesis was put forward by Swain, some researchers abroad and at home have conducted a few experimental studies of the noticing function. Swain and Lapkin examined whether output would lead to conscious recognition of problems and whether this recognition would trigger cognitive processes. Think-aloud protocol was used as a technique to elicit information about learners' internal processes. However, their study does not address the question of whether the awareness of problems during production can prompt the learners to seek out subsequent input with more attention. The experimental study done by Izumi et al. attempted to investigate this question by providing learners with opportunities to receive relevant input, to see whether they would notice and acquire the target feature in the input. This experimental study overcame the shortcoming of the study by Swain and Lapkin in an attempt to investigate whether awareness of problems during production would prompt second language learners to seek out subsequent input with more focused attention. However, one issue that remains uncertain is the relative contribution of the essay-writing tasks and the text reconstruction tasks.

In China Zhu Xiaowen's study was designed to measure the effectiveness of output practice in helping high school students acquire the past hypothetical conditional in English. The study done by Feng Jiyuan and Huang Jiao was designed to measure the

effectiveness of output practice in raising the noticing and helping learners acquire linguistic forms. Moreover, the study closely followed most experimental procedures of the studies done by Izumi et al., making only little modification.

In terms of the target form, the past hypothetical conditional in English was always chosen. Also their experimental subjects are always the English language learners or high school students. To further explore the utility of output in promoting noticing and acquisition, future research needs to examine the effects of noticing on other grammatical forms. Therefore the present study will examine the effectiveness of text reconstruction, on prompting noticing and acquisition of a different grammatical form, i.e., English passive voice. The subjects were Chinese college English learners.

2 Experiment

2.1 Experimental Purpose

In China, few researches have aimed to investigate the noticing function of output and experimental studies of the noticing function are urgently needed. Therefore, the present thesis is an attempt to conduct an experiment to investigate the effectiveness of the noticing function. As noted previously, output has a noticing function and it may promote second language acquisition by making learners recognize problems in their production and seek out relevant input with more attention to solve these problems. The passive voice in English was chosen as the target form in this experiment. The input material used in this experiment was designed specifically for the subjects, in which a situational context was built up for the use of the passive voice. The purpose of the experiment is to testify the effectiveness of the noticing function.

2.2 Experimental Subjects

Altogether sixty-nine freshmen (n=69) from non-English majors in Xiamen University Tan Kah Kee College were chosen as the subjects in this experiment. Of them, thirty-six students (n=36) majoring in Communication Engineering were randomly designated to be the experimental group (EG), and thirty-three students (n=33) majoring in Automation served as the control group (CG).

2.3 Experimental Hypotheses

The general questions to be investigated in this experiment are the following: 1. Does output promote the noticing of the target form? 2. Does output promote the acquisition of the target form? The noticing function of output generates the following two hypotheses:

Hypothesis 1: The experimental group which is allowed to produce output will show greater noticing of English passive voice contained in the input material than the control group only receiving the input material.

Hypothesis 2: The experimental group will show greater gains than the control group in the accuracy of the use of the English passive voice in the posttest.

2.4 Experimental Procedures

The experiment consisted of one pretest, the treatment and one posttest and the whole process of the experiment lasted three weeks. In the first week all the subjects took part in the pretest by which it was intended to get to know the subjects' initial knowledge of English passive voice. In an attempt to minimize the test effects, the treatment began in the second week. In the third week, this treatment was followed by the posttest in order to examine the effectiveness of acquisition. By posttest, we can get to know whether the subjects acquired English passive voice as we had expected.

The treatment was intended to give the EG subjects the opportunity to produce output. The CG did not produce, but instead finished multiple-choice questions related to the input. Each group completed the tasks in a separate classroom.

The experimental group was provided one passage titled "Internet" as input material containing the usage of English passive voice. Ten minutes later, the input material was collected and then EG was required to reconstruct the passage as accurately as possible according to some hints. Fifteen minutes later, the teacher collected their reconstruction and presented the input material again. EG was asked to read this input material again and underline the input material within ten minutes. After the input passage was collected, the EG subjects were then asked to produce a second version of the reconstruction within fifteen minutes. The control group read the input material and finished multiple-choice questions. Fifteen minutes later, the teacher collected the input material and then presented the input material without multiple-choice questions and asked CG to underline the input material within ten minutes.

2.5 Test Scoring

In the pretest and posttest two written test methods were used to asses the subjects' knowledge of English passive voice: sentences completion and translation of sentences. In the first part, ten English sentences were given (one point for each blank). The subjects were asked to complete the sentences using appropriate forms of the given words. In the translation part, the subjects were asked to translate five Chinese sentences into English (two points for each) using the given words. The pretest and posttest were the same in the test methods and given words but in the different contextual sentences.

2.6 Underlining Scoring

The mark of underlining is the percentage of the number of words the students underlined, which are related to English passive voice such as the form of be, the past participles of verbs and the total number of words underlined. Underlines in the treatment were examined to see whether output would promote subjects' noticing of English passive voice as well as to see whether the EG and the CG differed with respect to the proportion of target form-related underlines.

2.7 Statistic Method

The major statistic method used in the analysis is Hypothesis Testing. In hypothesis testing, we establish a null hypothesis first, one that assumes that there is no difference

between the sample observed and the population from which the sample is taken. In this experiment, the experimental and control group are regarded as the sample and the population respectively. The sizes of the two groups are both sufficiently large (36 in the experimental group and 33 in the control group). The null hypothesis (H_0: $\mu=\mu_0$) thus assumes that there is no significant difference between EG and CG in the noticing and acquisition of English passive voice. A second hypothesis, i.e. the alternative hypothesis (H_1: $\mu\neq\mu_0$) is also established assuming that the noticing and acquisition of English passive voice are significantly different between the two groups. To determine whether the difference between these two groups is a small probability event, we also need to set a confidence level for the test. The confidence level is a probability level beyond which the null hypothesis is rejected and is symbolized as α. Since in this experiment we are concerned with the variations between the performances of the two groups, the two-tail test is adapted. If we set the confidence level at 5%, the rejected areas at the both ends of the normal distribution curve are 2.5% respectively.

The *Z* values needed in the comparison of the two groups are calculated with the following equation:

$$|Z|=|(\mu-\mu_0)/(\sigma_0/\sqrt{n})|$$

From the Table of Normal Distribution, $Z_{0.05/2}$ is found to be 1.96. If the value of |Z| is larger than $Z_{0.05/2,}$ the null hypothesis is rejected and the alternative hypothesis is accepted. On the other hand, if the value of |Z| is smaller than $Z_{0.05/2,}$ the null hypothesis is accepted and the alternative hypothesis is rejected.

3 Analysis and Conclusion

3.1 The Analysis of the Pretest

After the scoring work has been done, the difference between EG and CG is reflected in the following figures. The mean score and standard deviation of EG (n=36) are 11.64706 and 2.832521 respectively and the mean score and standard deviation of CG (n=33) are 11.60811 and 2.930053 respectively.

From the figures above, we can see a slight difference in the mean scores between EG and CG. Can we say the subjects of EG perform better than those of CG in the pretest according to the mean scores? In order to know whether the difference is significant or not in terms of the statistic view, we have to turn to hypothesis testing in statistics. We are going to measure whether the difference of mean scores between EG and CG is significant in the statistical view.

Null hypothesis: There is no significant difference between EG and CG in the mean scores of the pretest. H_0: $\mu=\mu_0$

Alternative hypothesis: There is a significant difference between EG and CG in the mean scores of the pretest. H_1: $\mu\neq\mu_0$

Introduce the figures above into the formula:

$|Z|=|(\mu-\mu_0)/(\sigma_0/\sqrt{n})|$

$=|(11.64706-11.60811)/(2.930053/\sqrt{36})|=0.08$

$|Z| < Z\alpha/2=0.025=1.96$

H_0 is accepted and H_1 is rejected.

The result means that the difference in the mean scores of EG and CG in the pretest is not significant in the statistic view. Therefore, we can draw a conclusion that EG and CG's initial knowledge of English passive voice is the same.

3.2 The Analysis of Underlining Scores

Based on the scoring work, the mean scores and standard deviations of both groups are as follows: the mean score and standard deviation of EG (n=36) are 0.516824 and 0.201193 respectively and the mean score and standard deviation of CG (n=33) are 0.379613 and 0.182436 respectively.

From the data listed above, we can see the mean score of EG is 0.14 higher than that of CG in the underlining part. Can we say the difference between the two groups is significant according to the mean scores? What we concern most here is whether the difference reflected in the mean scores is significant enough to testify our hypothesis, namely, the degree of noticing of EG is higher than that of CG. In order to know whether the difference is significant or not in terms of the statistic view, we have to turn to hypothesis testing in statistics. We are going to measure whether the difference of underlining scores between EG and CG is significant in the statistical view.

Null hypothesis: There is no significant difference in underlining scores between EG and CG. H_0: $\mu=\mu_0$

Alternative hypothesis: There is a significant difference in underlining scores between EG and CG. H_1: $\mu\neq\mu_0$

Introduce these figures into the formula:

$|Z|=|(\mu-\mu_0)/(\sigma_0/\sqrt{n})|$
$=|(0.516824-0.379613)/(0.182436/\sqrt{36})|=4.51$
$|Z| > Z\alpha/2=0.025=1.96$
H_0 is rejected, and H_1 is accepted.

Therefore, we can come to the conclusion that the difference between EG and CG in underlining is significant in the statistic view. That means that the subjects of EG pay more attention to English passive voice than those of CG. One of the reasons why EG has greater noticing on English passive voice can be attributed to the output practice. After being given the input material, the subjects of EG are required to reconstruct this passage as accurately as possible. During the process of reconstruction, the subjects of EG find some problems with the usage of English passive voice. These problems in production enable them to be aware of what they do not know or know only partially about English passive voice. That is to say, when the subjects of EG reconstruct the input material, they recognize some problems with English passive voice and become aware of something they do not know but need to find out. Thus, when they are provided with the input material again, they pay more attention to the relevant language input to solve the problems they meet in the reconstruction. In other words, the activity of producing the target language may prompt second language learners to consciously recognize some of their linguistic problems; it may make them aware of something they need to find out about their second language. When the

subjects of EG cannot work out a solution, they turn to the input material with more focused attention. Therefore, we can draw a conclusion that output does give rise to the noticing.

3.3 The Analysis of the Posttest

In this section we will analyze the posttest results by comparing the different scores. The mean score and standard deviation of EG (n=36) are 16.64706 and 2.832521 respectively and the mean score and standard deviations of CG (n=33) are 11.93243 and 3.039468 respectively.

From the figures above, it is not hard to find that in general the subjects of EG perform better than those of CG in the posttest. Then we will turn to hypothesis testing to measure whether the difference is significant in the statistic view.

Null hypothesis: There is no significant difference between EG and CG in the scores of the posttest. H0: $\mu=\mu_0$

Alternative hypothesis: There is significant difference between EG and CG in the scores of the posttest. H1: $\mu\neq\mu_0$

Introduce the figures into the formula:

$|Z|=|(\mu-\mu_0)/(\sigma_0/\sqrt{n})|$
$=|(16.64706-11.93243)/(3.039468/\sqrt{36})|=8.73$
$|Z| > Z\alpha/2=0.025=1.96$
H_0 is rejected, and H_1 accepted.

Therefore, the difference between EG and CG in the mean scores of the posttest is significant in the statistic view. That means that the subjects of EG have acquired English passive voice more effectively than those of CG in the posttest.

In the process of reading the input material, the subjects of EG are mainly engaged in semantic processing, i.e., making meaning out of the input material, which does not necessarily lead to the development of syntactic competence. The output practice – text reconstruction moves the subjects of EG from a semantic analysis of the input material to a syntactic analysis of it. The subjects of EG not only receive the input but also produce the output, which enables them to start from the intended meaning and work towards an appropriate form that can convey the meaning.

The activity of reconstructing the input material prompts the subjects of EG to consciously recognize some of their linguistic problems such as making some grammatical errors. And such recognition or noticing pushes the subjects of EG to conduct a further analysis of the input material, enabling these learners to obtain a better understanding and command of English passive voice. In the second reconstruction, these subjects of EG can modify their mistakes of output to achieve repairs with their improved command or control of the target language. Hence, output pushes the subjects of EG towards the delivery of a message that is not only conveyed, but that is conveyed precisely and appropriately. This process of modification or repair represents learners' progress in their interlanguage system.

The present study overcame the shortcomings of the previous experimental studies. In terms of the target form, the past hypothetical conditional in English was always chosen. Also their experimental subjects are always the English language learners or high school students. The present study took English passive voice as the target form

and took Chinese college English learners as experimental subjects and the results of the experiment confirm our two hypotheses set in the beginning. The subjects of EG not only show greater noticing but also achieve better acquisition of English passive voice than those of CG.

4 Teaching Enlightenment

To conclude, the present thesis has attempted to make people look at the role of output with a more rational perspective. Producing output in second language acquisition can promote learners' noticing and acquisition of linguistic forms. Thus Teachers' role should be adjusted. To be exact, teachers should not keep dominating the classroom by pouring knowledge. They should create situations that encourage students to participate in pair and group interactions that provide not only comprehensible input, but also comprehensible output through collaborative negotiation and repair. As a whole, adopting output-based teaching approaches can provide a context for the realization of output functions, paving a way for successful second language acquisition. Hopefully, the study and its inspiration will benefit Chinese College English teaching and help students better acquire the language of English.

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Analysis on Chinese Special Education and American Special Education

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Abstract. In this paper, we give the broad and the narrow definitions of special education. On the basis of the current conditions of American special education, we analyse the problems of special education in China. Furthermore, we find the differences of special education between two countries, e. g. social system, law and rules and management system, etc. After that, we put forward some advice to the development of Chinese special education.

Keywords: China, America, Special Education, Broad Definition, Narrow Definition.

1 Introduction

This article is mainly about special education in the narrow sense, by means of the statement of the history of the development of special education of China and America; it also makes an analysis and a contrast of general and specific policy of education and interrelated legal safeguard and thus it has a deep thinking and searching to enhance and improve the special education in China.

In America, which is one of the most developed countries in special education in the world, the special education is playing a decisive role in the education system. In particular, over the past nearly 20 years, our society has attached greater importance to the effect of special education. And early intervention is an important part of American special education system; it can make up for the handicap of special children and let them integrate into normal society as soon as possible. Moreover, confluent education is the essential part of American special education system; it provides the same right of learning environment and education to all of students. In the process of putting early intervention and confluent education into effect, the effective legal safeguard plays a key role and provides a good condition for the development in the process. Thus, probing into the development of early intervention and confluent education of American special children in legal security system is of far reaching importance for Chinese special education, such as to improve and perfect the legal framework and policies and measures of Chinese special education, and to promote the healthy development of Chinese special education.

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2 The Brief History of Special Education of China and America

A. The Briefing of American Special Education

America is the earlier country to pay attention to special education and focuses on intelligence tests in early time. However, the intelligence tests were used in determining which kind of children could be taught by cause of regular school class. The handicapped children couldn't accept education and usually had been sent into rehabilitation home [1]. At that time, the rehabilitation home which took the handicapped children in and controlled various problem children such as the blind, the deaf, the retarded, infantile autism and youthful offenders were much difficult, and it also couldn't achieve understanding and support from normal people, society and government.

As a result, there were not enough care and protection [1]. In the early 19th century there were some professionals getting started to pay attention to the education for the disabled; and then built up some special schools to help people with sensory handicaps, especially the blind and the deaf. Some special schools had been built up in some states, when the government not only offered the care to them in their daily lives, but also provided education to them. During this period, some states began to issue the certificate to teachers who were teaching the students with disabilities [2]. In the 1950s and 1960s, the civil-rights movement was another support to promote disabled people to gain equal right [3]. Since then, the parents of exceptional children had begun to appeal to society and government to provide more education opportunities. From this time forth, the specific curriculum to point at students with mild intellectual impairment and behavior disorder had became more and more. Government and experts also got started to research the effectiveness of special education classes and universities began to train special education teachers.

In the 1970s, America issued some documents about law of reform one after another. From this time on, it has made a change in the attributes of special education. Law of Special Education for the disabled got through in 1975, which made normal people realize that education was a civic right rather than a privilege. So in 1977, this law was reaffirmed as Law of Education for the disabled, and then it was renamed as Promotion Law of Education for the disabled again in 2004. These laws and regulations of special education always made sure the students with disabilities and learning disabilities have equal right to pursue and supervise the education which they received. For these reasons, on the basis of lawful protection, American special education formed the standard and perfect system, to let disabled persons enjoy the right to receive education.

B. The Briefing of Chinese Special Education

Chinese special education started fairly late. Before the founding of New China, there were 42 special education schools, with an enrollment of some 2380 blind and deaf students. In old China, special education schools invariably restricted themselves to blind and deaf children, and most special education schools were private schools. Since the founding of New China, special education has been taken more seriously. Premier Zhou Enlai signed the decision about school reform as early as in 1951, to

stipulate to set up specific special schools for the blind and deaf; to symbolize that special education had been an important component of the National educational system of new China and special education had started a new development.

From the early years after the founding of the People's Republic of China to the mid 1980's, special education schools were always playing the main role and as the main form of Chinese special education. From 1954 to the Cultural Revolution, the returning students of former Soviet Union have ever carried out an experiment on education of hypothermia in Beijing and Shanghai.

Being started from 1979, special education classes for mentally handicapped children were established in Beijing; in 1983, the first special school was built. In 1985, local government wanted to economize on educational funds and improve the enrollment rate of handicapped children; the governments set up special education classes in general schools. On the basis of the educational theory of mainstreaming movement, some large cities such as Beijing and Shanghai began to admit handicapped children to normal class, which is called learning in regular class. In 1988, the beginning of first National Special Educational Working Conference had the milestone in the history of special education development. China in recent years has formulated and put into effect the Law on Compulsory Education, The Law on the Protection of Disabled Persons, Regulations of Education for the Disabled and the assignment to develop special education is imminent. From 1990, in order to make the handicapped children in countryside receive the same education, the form of learning in regular class was also achieved in countryside, and this form is similar to inclusive education which was proposed in international in afterwards. After years of efforts, China has formed a compulsory education setup for disabled children, which takes special-education schools as the backbone.

So far, the Chinese government has taken education as a strategic key for the country's development, and great progress has been made in this field, including special education. Now the number of special education schools has achieved 1539 and enrollment has reached 370000. China has made great efforts to develop education for the disabled by opening special classes in ordinary schools and set up special education schools.

3 Differences of Special Education between China and America

By the means of comparative analysis among the phylogeny of special education of China and America, we can discover that some common denominators and differences still exist.

A. Difference in Education Idea

Confluent education is the most notable symbol of American special education. It is required to pay more attention to what they have and what they should do about the identification and assessment of exceptional children. Teachers should have full confidence in this kind of students from begin to the end, and provide the complete education to conform to their abilities and needs. This education view is connecting with people, respecting individual difference and never giving up any students.

Compared with Chinese teachers, American teachers pay more attention to individual development of student; in one word, students play the main role in the process of learning. On the contrary, Chinese education is attaching importance to teachers' leading role in teaching process, and teachers should have a carefully consider that all students' needs. As a result, in China, teachers tend to ignore characteristics and needs of students, especially the needs of exceptional children.

B. Difference in Special Education Teachers

Teachers are crucial in the quality of teaching. In America, besides being staffed by specially trained teachers, special schools are supported by specialists such as educational psychologists, speech therapists, audiologists, physiotherapists, occupational therapists, school nurses and social workers [4]. So the quality and professional degree of special education teachers are high. For example, in 1998-1999, there were 38700 full-time teachers devoting themselves to special education. It included 34700 people to gain the qualification authentication of special education, 15000 people to obtain the qualification authentication of social worker for exceptional children and 9500 people to achieve the qualification authentication to become expert in special education. In America, special education teachers always have high education and most of them achieve high academic degree such as Master or Doctor. Certification system is the standard to check and evaluate the qualification of special education teachers. If the service objects are visual impairment, hearing impairment, infantile autism or other physical defects, teachers still need professional certificate involving in these domains. It's difficult to gain these professional certificates and it has timeliness, the period of their validity is about 5 years and if teachers want to continue their teaching career, they should pass the professional test after 5 years.

In China, there is a great difference in education background of special education teachers in different regions, cities superior to countries, and economically developed regions superior to economically undeveloped regions. At present, the quantity and quality of special education teachers are difficult to fit into the needs of development of social economy and special education. Especially our society lacks trained special education teachers, and specialized persons such as psychological consultation teachers, speech therapist, audiologists, physiotherapists, occupational therapists and so on, which is the most outstanding problem to Chinese special education.

C. Difference in Special Education Fund Investment

In America, the sources of special education fund investment are from three ways: first is a relief fund coming from federal government; second is a relief fund coming form the state government; third is property tax and donation coming from society. The last two sources take up 80%-90% in general budget of special education funds, and the relief funds of special education which come from federal government is about 10%. However, there are only 5 financial departments in China providing subsidies for special education. It shows that there is a huge gap between the education fund investment of China and America.

D. Difference in Laws and Rules of Special Education

There are a series of laws and rules to support special education in America and six fundamental principles which are zero reject assessment of non-discrimination, free and befitting education, least restrictive environment, legal safeguard and interaction in parents and children to put these laws and rules in practice. Every principle has specific demands and implements and the specific procedures to evaluate and check special education. In short, the development of American special education is in accordance with laws and rules.

In China, there are some laws which relate to special education and people with disabilities have promulgated, such as Law of Education, Compulsory Education Law, Security Law of the Handicapped, Special Education Ordinance, The Interim Regulations of Special Education and some other laws make clear the specific provisions to protect the equal rights of citizens. This series of laws give a great push to the development of Chinese special education, whereas as time goes on, current laws and rules of special education fail to adapt to the development of special education. The problems include poor operability and insufficient authority.

E. Difference in Management System of Special Education

To undergo redistribution or dispersal away from central authority is the key of American special education management system. Federal government plays a part in guiding, and every state government is quite capable of running the department of education alone. There is not unified teaching program or textbook in the whole nation, and the specific teaching content depends on local government, schools or teachers. In the process of classroom teaching, teachers have enough self-reliance in teaching arrangement and implements initiatives to address the specific requirements of groups in special need. On the contrary, preschool education, elementary education, secondary education, higher education and special education are controlled by the Ministry of Education's unified management. The same teaching content is difficult to meet the special needs of students and learner autonomy is always ignored by teachers, schools and parents.

F. Difference in Management System of Special Education

From "mainstreaming movement" of America, it is easy to find that parents are still playing a role that cannot be ignored in the process of fight for right of equality and right of education to their disabled children. First, the laws of a country ensure parents of disabled children have equal right to participate in and supervise special education; second, parents form a specific group by themselves to make an appeal to society and strive for social support; third, they are really substantively involved in teaching process of exceptional children and can perform the function of supervision. However, in China, parents of exceptional children lack initiative and positivity to take part in teaching activities; parents only pay attention to their own children, and then there is not enough communication among parents to make some social effects. It's the shortcoming of Chinese education, especially special education in China.

4 Enlightenment and Reflection in Development of Chinese Special Education

By the means of comparative analysis in American special education system, we have a lot of useful methods and experiences in some parts of special education. Chinese special education needs to lead away from disadvantages of special education and learn from America.

Treat special education in a rational way and let special education form an important part of Chinese education system. Ensure exceptional children have equal rights of education and development, offer fair treatment to help them build up the wholeness of life with mental health and optimistic mood. It's the real purpose of special education. In view of Chinese traditional and conservative culture and values, compared with American special education, the level of economic development of China is too low, the population is large and the group which needs to receive special education is large in current situation. For the development and future of special education, Chinese special education needs to consider the condition of a country and enhance the blending and cooperation of special education and general education; by the cooperation between family and school, we can improve the quality of social blending, make sure that children with special needs gain assistance and they are educated in a real sense [5]. For example we can put individualized education into practice in general education classroom and use special education methods in curriculum of general education. Make sure that various needs of exceptional children can be met in general education class to the greatest advantage.

First of all improve and perfect current policies and laws of special education. And then it should further details of the related rules and laws, make clear the relationship between responsibility and right, and strengthen law enforcement. The first to strengthen law enforcement of special education should make the rules of special education relate to laws. And then enhance guiding and operability of rules and laws. The other step is to make sure the relationship between responsibility and right, and special education laws can be truly used to improve legal effect.

The crucial point of the quality of instruction is teachers, who should be selected carefully. There should be contingent of good teachers. Whereas there is a lack of special education teachers who are trained and full of currently teaching experience in the schools of China. So improve and perfect qualifications of special education teachers, on the basis of different levels of teachers to confer different levels of teaching certification to them. Government should not only upgrade the professional qualification of teachers and enhance their status in this community, but also build up the ranks of teachers and raise their professional ethics and competence. Its purposes are to bring the initiative of the special education teachers into playing, to increase efficiency and teaching quality; to enhance teaching qualifications and to build a stable and qualified teaching force. Make the development of special education in China keep pace with the general education in China, to give undivided attention to provide optimum education and promote the equal right in social life to people with disabilities to make them have a high standard of living.

The central authority and the financial authorities of local governments should achieve the following four steps to support the development and future of special education in China: 1) To launch free compulsory education for the students with

disabilities. Meet the special needs of the students with disabilities, further raise subsidy level and enhance its quality and level of Chinese special education. 2) To strengthen the development of special schools and special education teachers as the crucial link in promoting students with disabilities and special education development. 3) Within its financial capacity, the government should make great efforts to support the students with disabilities in developing education. 4) To increase input in special education, to make sure that special education schools work systematically methodically and the normal school supplies of special education school are enough.

5 Conclusion

America is the most developed country in the world, its economic progress closely bound up with educational development. So America is also a country where the education is widespread. Special education has gained good experience, work style and practices in long-term practice and development of American education. Special education is also an important component of education in our country. We can draw the successful experience of the trend of special education in the United States and integrate with the concrete practice of China, research the regular pattern of special education and form the philosophy of special education, special educational mode, developmental pattern of special education and the new system of special educational assessment with Chinese characteristics. Make special educational development of China accord with national situations and fully satisfy the people's needs of education. We should explore a new route of special education which not only integrates with the world, but also demonstrates Chinese characteristics.

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On the Application of Geographical Information System Technology in Curriculum Teaching of World Economic Geography

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Abstract. GIS is one of the leading technologies owning functions of geo-spatial data acquisition, processing, management, analysis and visualization capabilities, and it has been seen as the third language of geography science. We analyse the role of GIS in Curriculum teaching of world Economic Geography which is shown as wall maps making, spatial inquiry, virtual reality and spatial analysis and statistics. We have also made a case study based on the Platform of MAPGIS. It's pointed out finally that GIS technology has an important support function in Curriculum teaching of world Economic Geography and has a broad application prospect.

Keywords: GIS Technology, World Economic Geography, Curriculum Teaching, Application.

1 Introduction

GIS, namely Geographical Information System, is one of the technologies which synthesize many subjects such as computer Science, geography science, cartography, surveying, and so on. It has the functions of access, processing, management, analysis and visualization to the geographical spatial Information. On the one hand, it extend the functions of traditional media and multimedia, on the other hand, it also makes for bringing spatial characteristics, general characteristics and rational knowledge into play.

In the teaching of World Economic Geography for university students, the traditional geographical graphics and maps can no longer meet the needs of geography education on mobilizing the enthusiasm of students, developing practical ability of students. With the maturing of GIS and wide application, it has become the future trends in teaching reform that we introduce GIS into World Economic Geography classroom to optimizing Teaching.

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2 Analysis on the Role of GIS in Curriculum Teaching of World Economic Geography

2.1 Wall Maps Making

GIS has powerful mapping function. The teachers may use GIS to make all kinds of wall maps with clear theme, accurate projection and flexible graphics performance. The teachers can still easily manufacture many images in various digital formats with the help of capture software, and then apply in multimedia courseware. In addition, GIS mapping is also used to solve the problems of traditional geography teaching, such as the flip chart paper easily damaged, difficult to preserve and insufficient number of issues.

2.2 Spatial Inquiry

We can not only check the properties of geographic entities through location by using GIS software, but also inquire the shape features geographical entities. What's more, we can check for conditions through GIS. For example, on teaching the administrative divisions of Asia, the name and distribution of administrative units at all levels in Asia can be displayed in a dynamic flash way. Moreover, as long as the corresponding properties are given, we can instantly check the size, population, gross domestic production (GDP) of each administrative unit.

2.3 Virtual Reality

The most important feature of virtual reality is that participants can interact in a natural way with the virtual environment, which has changed the mode of understanding the environment of human in the past mainly relying on personal experience. For instance, when teaching Japan's topography, the teacher may combine high-resolution remote sensing images and digital elevation model of the ground (DEM) to generated three-dimensional geographical environment of Japan. With the high-resolution remote sensing images, the students can both see the ground vegetation characteristics, and find the overall topography of the land and local features. Through GIS technology, a real landscape has been reproduced, and the students have got a preliminary understanding of Japan staying at home, which lay a good foundation for future learning.

2.4 Spatial Analysis and Statistics

Spatial analysis and statistics is an independent research field of GIS. Its main feature is to help determine the new spatial relationships between the geographic elements. It has not only become an important sign different from other types of information systems, but also provided effective tools for users to solve various specific issues. We can Take spatial overlay analysis as an example to understand the situation of agricultural production in Australia. As long as we overlay maps of vegetation type, terrain characteristics and climate conditions, Australian agricultural production patterns and causes can be obtained soon.

In order to use GIS for data analysis, the data must be collected on a database, then we can use the GIS data analysis function of geography. GIS software provides many analysis functions, including query and analysis, overlay analysis, buffer analysis. The final results of GIS analysis eventually need map visualization and statistical tables and charts to realize. For example, GIS can quickly tell us the national distribution of population over 100 million in the world; and analyses the total population within both sides of the 40km range of New Asia-Europe Continental Bridge, and so on.

3 Case Study: Curriculum Teaching of World Economic Geography Based on the Platform of Mapgis

Among all of the GIS softwares, Mapgis is just the one of desktop visualization mapping information system which is more powerful, more convenient to use. For the teaching of world Economy Geography, MAPGIS can provide wealthy functions of map information generation, management and maintenance, so we can use it to realize map showing, map plotting and geographic data storage.

Here, we take the course of United States as an example to demonstration application of MAPGIS in the teaching of world Economy Geography

3.1 To Establish and Output the USA Administrative Region Map and All Kinds of Natural, Economy Key Element Maps

We can draw all kinds of electronic map of United States with natural and economic key elements through drawing instrument provided by MAPGIS. We may use every kind of graph elements of toolbox in spot, line, region and so on, and many performance types such as rich colour, map code, text type, linear etc. to exhaustive, direct-viewing, demonstrates each kind of electronic map vividly. MAPGIS is able to provide the geography attribute of data, is capable to associate with the updated database and reflects the change situation accurately and promptly.

3.2 To Update the Database in the USA Map, Carry on the Comprehensive Graphic Solution

MAPGIS's basic function is to enable teachers to transform the tabular data into geographic graphic display, and then to operate and analyse the display results. The display objects of the United States include population, economic development level, urbanization, ethnic, religious, and so on. MAPGIS also allow create database by inputting data yourself and renew the map unceasingly.

3.3 To Select, Query and Count Geographic Information in the United States Map

We can Inquire, analyse and count inter-related geography objects and its data attribute on the screen. The simple inquiry Includes object inquiry tool, region inquiry tool, buffer inquiry as well as some commonly used function inquiry. Regarding the quite complex inquiry, we may run the MAPBASIC program and write process to

carry on. For example, we can use SQL to select inquire in the map of the United States the cities of population density greater than 500 persons / sq km, to inquire and calculate the American total population, the total land area and the US average population density and so on. Query results can be displayed quickly in MAPGIS.

3.4 To Make Use of Different Information Content to Manufacture Thematic Maps of Different

The thematic map is refers to use each kind of graph style (e.g. color or packing pattern) to demonstrate some kind of information in figures and diagrams, maps. It can make the data vivid, visually displayed in the thematic map.

Through cross-correlation's geography data, MAPGIS may rapid produce each kind of thematic map which conveniently meets the teacher's needs, like Bar charts, pie charts, dot density map and so on. These thematic maps cause the data more easy to understand through the polygon multi-level colorations

4 Conclusion

As a combination of traditional discipline and modern science and technology, GIS born out of the map, they are the geography information carrier and the transmission tool. If we call the map a second language of geography science, then the GIS is the third language. By introducing GIS in the world Economy Geography teaching, we have not only enriched the geography classroom instruction content, also changed the geography classroom instruction form. It has an important supporting role for improving the quality of teaching.

As the third language of geography science, the importance of GIS should be fully pay attention to by geography teachers. The teacher must have the ability of applying the modernization tool of GIS to solve actual problem, simultaneously should give this kind of ability instruction to the student. In short, with the increasing popularity and in-depth of information technology education, GIS technology will certainly to occupy an important position in the geography curriculum teaching.

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Methods and Ways to Enhance the Moral Infiltration Education on Students

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Abstract. It requires schools to innovate the moral education mode in new period and under new background; changing the pure mode of indoctrination into indirect infiltration education, in this paper it implements the moral infiltration education comprehensively in separated phases from four aspects of students' life, learning, school environments, and management systems, and puts forward new requirements on teachers' personal charm and working methods.

Keywords: schools, moral education, infiltration education.

1 Introduction

Moral education, as the decisive factor in the construction and development of the spiritual civilization of mankind, plays a significant role in the social individuals, countries, nations and even the healthy development of human society. How to improve methods for schools in enhancing the moral education on students, so as to train talents with strong professional competence and high moral character to meet strategic targets of Chinese socialist modernization construction in the 21st century has become a new topic. Although countries in the world at present are different in political, economic, and cultural backgrounds, for conducting the moral education, all attach great importance to the recessive education. Recessive education, also known as hidden curriculum, refers to the adoption of the not so obvious hidden method to convey social values, and to conduct the moral education meeting the class on students. The concept has been proposed by the American scholar N • V • Owoler in 1970. Its characteristic is to achieve aims of education in the process of infiltration. Moral infiltration education, as a direct manifestation of the recessive education, refers to a kind of unconsciously influenced and imperceptible education conducted on educated people by carriers. It constructs an atmosphere to influence and edify education objects with the help of carriers. As the saying goes, touch pitch, and you will be defiled. This is the infiltration.

The ideological and political work in new period should attach importance not only to the dominant education, but also to the recessive education, and it can achieve a greater success in the ideological and political education through the moral infiltration education. The work of moral infiltration education, in order to achieve the desired

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results, needs to depend on the edification firstly and rely on the guidance secondly. Edification, in the outer level of moral infiltration education, means that educators make full use of social environmental factors and the educational context created by educators' teaching by their own examples to infiltrate their intents gradually into their minds, to influence and edify educated people, who consciously or unconsciously are spiritually influenced, sentimentally edified and philosophically enlightened through imperceptible influences, leading to their sublimated and improved ideological and political moral character. It requires the contents of infiltration to combine with the ideological characteristics of young people, and combines education with a variety of carriers. Guidance, in the inner level of moral infiltration education, requires educators to guide educated people's behaviors into the direction which is in line with the interest requirements of a certain social group, and to transform such behaviors into educated people's conscious activities. Therefore, the infiltration of moral education is a targeted activity. It carries out various activities through the organization of education objects, and transforms through the voluntary participations of the education objects into their own ideologies, coming to understand what are the truth, goodness and beauty and what are falseness, evil and ugliness, making "want me to do" become "I want to do", as well as changes education into self-education, as an educator Ye Shengtao said that the purpose of education is to achieve no education.

2 Goals and Contents of Moral Education on Students for Schools

The school is an important stage for students to adapt to social developments, achieve individual and social integration and unification, and transform from a "natural man" to "social man"; schools should be based on social value standards to train and indoctrinate students into members of society in line with requirements.

The purpose of moral education is to make individuals socialize in moral, that is to act in accordance with the norms and ideal methods consistent with the living society. In the point of philosophical view, the moral education regards the "human existence and comprehensive development" as the theoretical basis, theoretical purpose and logic premise; similarly, it can take the "human existence and comprehensive development" as the design basis and the method basis for observations and assessments of their own frameworks. The ultimate requirements of the moral education goals are, "to respect for human existence, to achieve human construction and human development, and to shape the perfect personality." Human comprehensive development of the basic viewpoint of Marxism emphasizes that the human self-consciousness obtains free expression, and human personality, various needs and talents, and potential capacity obtains fully development, meanwhile it emphasizes that human social relationship obtains highly abundance. [1]

Marxism holds that human values are divided into social values and self-values, in which social values lie in individuals' contributions to the society, being human's responsibilities for the society and inescapable missions for individuals as objects; while self-values lie in human self-developments, manifesting as human self-selection, self-transcendence, and self-improvement. Therefore, students' perfect

combination of social values and self-values among students is the ultimate goal of the moral education for schools.

In order to achieve students' perfect combination of social values and self-values, the contents of moral education have to cover all aspects of students' learning and life, including the living environment construction, specialized learning, and social practices, etc., thus moral education is a systematic project, which has to integrate all resources, all people in schools making concerted efforts and using appropriate methods to enable to achieve effects.

3 New Methods to Moral Education - Infiltration Education

Students in the twenty-first century, because their living environment has significant changes in comparison with previously living environment, with the development of market economy, in addition to superior living conditions, great changes in the ideological method of thinking also having taken place, they are with strong personalities and strong-minded, simply using the way of indoctrination to tell them what ought to do, what is right and what is wrong, which is impossible for them to truly accept your point of view and therefore make changes.

They are rich in ways to access to information, not just limited to newspapers and magazines, more from the Internet and mobile phones, in which the Internet is not only informative, but also richer contents and more timely reports. While mobile phones make information communications among students in different regions smoother and more timely, stepping across restrictions in time and space and geographical constraints, as compared with past students, wider fields of vision and more receptive to new things available among them. They pay more attention to their own feelings, and will not simply accept all views and opinions from others, think in their own ways instead; they only accept what they agree with, but in contrast they will have resistant moods to what they do not agree with. Therefore, simply indoctrination of moral education for students not only is ineffective in acceptance, but also might result in students' negative mentality. This requires us to change our educational methods, by changing the one-way preaching to the two-way communication, and changing direct indoctrination to indirect infiltration.

4 Contents Covered by Moral Infiltration Education

Carriers of moral infiltration education should be the entire environment in which students live, covering all aspects of students' learning and life, including in every link of teaching, administration and daily life as well as logistics support, while the method of infiltration should be unconsciously influenced and imperceptible. It is to carry out specifically through the following ways and methods.

4.1 The Aspect of Life

The student life is an important aspect that firstly needs schools to focus on, through caring the student life, making students experience the school care, to enable to consciously abide by rules and regulations of schools, and to enable to focus on

learning, more important, learning how to live is the first step for students to take into the community. For example, improving the living environment, with the social and economic development, living conditions have been gradually improved; TVs, computers, sanitary facilities, and air conditioning, etc. have already become necessities for the vast majority of families, in which schools if possible, can provide conveniences as much as possible to use equipments and facilities, not only to provide students with the feeling of home, meanwhile, through their own arrangements of life and reasonable allocations of living expenses, making students know the difficulties of life, to develop the habit of saving and to experience more hardship in parents' cultivation on their children, helpful to train students' responsibilities.

4.2 The Aspect of Learning

Learning is cognition, which should not just acquire students to learn knowledge, but should be the means by enlightenment to teach students to learn how to learn and master cognition. At the same time of learning knowledge, it should also learn to be hands-on, to use their own heads, to handle affairs, to survive, and learn to live together with others. In order to make the perfect combination of students' social values and self-values, it is unable to be achieved only relying on teachers' indoctrination, but it is crucial to depend on their own learning. The combination of learning and thinking, and the combination of action and knowledge, both are very important for students. Human thinking, human ideality, human creative spirit, and human moral norms are unable to be taught-by-doing by teachers, but rather ideality and thinking are decisive in human life. Teaching is to not teach, which does not lie in what a great mathematician or a writer a teacher is, but lies in the formative education that can be provided by a teacher for students, teaching them to learn to think, and then use their own creative thinking to learn, to learn for life. [2] This requires us to apply scientific methods to perform the infiltration education on students, only by eliminating various barriers resulted from status differences between educators and educated people, making the latter feel to get along equally to be educated, so as to enable to better mobilize internal factors and initiatives of educated people, to make education activities achieve the maximum effects.

4.3 Campus Environment

Xunzi had regarded the evil nature as the starting point for education, and greatly emphasized on the "gradual accumulation" learning method; the so-called" accumulation" referred that the individuals continue to accept extraneous interferences, while the so-called "gradual" referred that the outside world imposes consecutive impacts on the individuals. The environment makes a great impact on human, as " The fleabane growing in the field of hemp becomes straight itself; the white sand mixed in the black sand becomes all black." [3] It is to emphasize the educational environment plays the infiltration role for educators.

Create a campus cultural environment favorable to student developments, and strive to build a harmonious community humanistic environment and a beautiful natural environment. According to students' inner acceptance psychology and

motivational needs, flexibly organize a variety of educational activities to reduce students' resistant and exclusive psychologies, integrating education in invisibility. Schools should make full use of superior resources of human talents to hire influential experts and professors to offer various series of lectures, carry out multi-form, high quality, healthy and lively, and elegant cultural activities on campus, and train students' spirit of unity and cooperation and good humanistic quality; meanwhile schools as managers should actively organize various associations and societies, and adhere to the purpose of educating talents in the community activities, so that students in the activities can both increase their knowledge and cultivate their sentiments, reaching the purpose of educating talents quietly. At the same time it is to strengthen the whole environment integrating family education, school education, and social education, in order to strengthen students' moral cognitive schemata.

4.4 Managerial System

The establishment of the supporting managerial system is the software to conduct moral infiltration education on students, and is the guarantee to achieve goals of moral education for schools. The managerial system that forms clauses, standardizes and institutionalizes requirements for students provided by schools is the hard bound for students. Its competitive and incentive mechanisms through awards to encourage excellences, and through punishments to restrain perversities, integrating education into management, not only are more effective to enable to increase the effectiveness of moral education, but also are conducive to form a vibrant situation competing for advance, learning advance, and helping to learn each other, to consolidate and expand achievements of moral education.

Focus on positive education, conducting the positive strengthening management of students' behaviors, and establish various aspects of prototypes and models, with the power of examples to influence and drive students. As it should be, appropriate negative reinforcement also plays the role of discipline and correction for violators.

5 Moral Infiltration Education Should Be Implemented in Phases

Aiming at the property of phases in students' growths and developments, moral infiltration education should be implemented in phases, and can be divided into three phases of the new students' adaptive phase, the academic deepening phase, and the graduation phase. Between each phase, it should follow the progressive principle of "proceeding from the shallower to the deeper, and following in proper sequence", so that each phase can be joined together one another, to truly achieve that the lower phase of education is the foundation and preparation for the higher education, and the higher education is the continuation and deepening of the lower education.

The new students' adaptive phase. It should focus on the concern education to make students adapt to the learning and living environments of schools as soon as possible and understand the management systems of schools, and guide students to establish correct objectives so as to establish the direction of the follow-up learning, thus they have the motivation to learn. For example, taking "I hope to become what kind of

person in the future" as the theme for discussions, making students realize that the economy is the foundation, but not the ultimate goal, and it should have a better social status and strong social responsibility, with high degree of recognition by the society, which requires all students to constraint and improve their own behaviors based on learning professional knowledge well, to be responsible persons, whether for enterprises or for the society, and to become a qualified talent with all-round coordinated developments.

The academic deepening phase. This phase is mainly professional learning and core-course learning; in addition to adopt cases and the heuristic teaching, it also can design programs based on students' characteristics, to enable students to participate in completion, and to allow students to modify programs, enhancing their capacities in practical applications; it emphasizes on extra-curricular practices related to professional curriculums; the problems encountered in practices can motivate students' desires to conduct spontaneous learning and independent learning. During the participation in social practices, schools should integrate resources from all sources to be participatory for all and to conduct collaborative managements. For example, professional teachers responsible for professional guidance and counselors responsible for organizations, etc. full participations enable to improve the effectiveness of practical education, and also enable to make the work of moral infiltration education carry out in practices in depth.

The graduation phase. Before post practices, schools should be fully prepared to invite various positions in enterprises, including the most basic level and the higher management level of staffs, to introduce enterprises' situations, requirements for each post, enterprise systems, enterprise working environments, and enterprise cultural constructions, so that students can be aware before participating in post practices, to avoid lack of acclimatization; after all, schools and enterprise environments are totally different. For example, a student practices to work in a well-known chain enterprise; at the beginning, she is allocated to the cashier position to work together with one colleague, but she does not know why her colleague always does not look pleasing to the eye; she is often lectured by her colleague, and even lending things to other colleagues has been lectured by her, while herself lends her own things to others as before. For she just starts to practice, she is a green hand in business, and runs into such a strange thing, making the student be at a loss. In fact, such situation will be encountered in many enterprises, for staffs in some positions due to their low level of education, when they encounter new students, most of them will have jealous psychology shown to be extremely bossy to others; they in fact show excessive self-esteem due to their over-inferiority, with a kind of natural bewaring of strangers, but after getting along for a long time, with deepening understandings, the relations will be sure to be improved. For those students who just practice, it is difficult to understand, therefore they need to gain some understandings about enterprises' situations and possibly existing problems in advance, then they will not be perplexed by similar problems.

6 Requirements for Teachers by Moral Infiltration Education

6.1 Improve Teachers' Personal Charms

Teachers are main subjects to organize teaching and educational activities, whose thoughts, characters and knowledge will play an exemplary role in teaching and educational activities for students. Such exemplary role shows teachers need to use their own lofty thoughts, good characters, profound learning and true, good and beautiful behaviors to influence students, setting examples for students. Every thing that teachers require students to achieve, themselves must first realize it. Confucius said, "Teachers set examples to correct, who dare not to correct." A person needs to be self-reliant before he can rely on others, and needs to be correct himself before he can correct others. Therefore, teachers should focus to consciously set examples for the student in the aspects of moral characters, knowledge skills, and civilization and politeness, etc., which is the best moral education for students. [4] Teachers impart knowledge in the discipline system; meanwhile they need to educate students on correct conception of world and view of life.

6.2 Understand Students and Mingle with Students

In order to set examples for students and to use their own actions to affect students, it must have students accept teachers, and then they can turn to accept teachers' education and behavioral views. In order to break the gap between teachers and students, teachers need to know about students' psychologies, what they are thinking about and their thoughts, to enter students' communication networks, and even to learn their language of communication. For example, adding into QQ groups of students to chat with them, and to discuss together on a certain topic with students, through QQ spaces of students, in depth perception of students' thoughts and statuses, only after knowing about them, teachers can understand, and then can be accepted, thereby to better play exemplary roles.

7 Conclusion

In short, moral education of schools must change the original strategies, by changing simply indoctrination into scientific infiltration, and through the comprehensive system design of students' living environment, infiltrate the moral education into all aspects of students' learning and life, all people in schools making concerted efforts and integrating all resources to enable to achieve ideal effects.

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Design of Tourism E-Business System Based on JavaEE Multi-pattern

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Abstract. This paper proposes that technology of framework for SSH and JavaEE Multi-pattern is available in the development and application of tourism e-business system which is based on B/S model, and presents the rapid procedure of design and development during the course of Web information system. Result proves that technology of framework for SSH and JavaEE Multi-pattern design robust, efficient B2B E-business system. This framework technique not only make a good use of resources but also make the project developing to be compact and clear in flame. Besides good expansibility and maintainability also are provided by this kind of system.

Keywords: javaEE Multi-pattern, SSH framework, tourism e-business system, façade pattern, MVC pattern.

1 Introduction

Currently, the tourism e-commerce to solve the most pressing question is: 1 how to integrate domestic and international tourism and publish information; 2 How to find effective and accurate positioning of customer resources so as to improve the success rate of tourism trade; 3 how to do everything possible to reduce and enterprise, business and transaction costs between individuals; 4 how to improve the integration of tourism resources within the enterprise and so on. These are required to complete a powerful e-commerce systems. In the tourism e-commerce business logic within the system as complex, fast changing pace of business development business, and involves a large number of financial transactions. This system's security, stability and complexity made more demanding. Relative to the. NET platform, based on JavaEE platform for its platform independence, scalability, high, strong security features such as excellent tourism business systems gradually become the preferred solution.

Among the many solutions in JavaEE[1], EJB-based J2EE architecture of the various components distribution business to a different server in a distributed operations between the components need to be associated, but its operation of the system performance of the higher requirements. This will result in high cost of enterprise, now has largely been abandoned; the second is based on the lightweight J2EE-based solutions of its weaknesses are: 1 business logic and data access layer

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coupling between the high degree; 2 lack of a unified system-level support services; 3 it does not have distributed processing capabilities; and this paper, how to model multiple JavaEE and improved lightweight SSH combined organic framework to design a clear structure, easy to maintain and efficient operation of tourism e-commerce system architecture.

2 JavaEE Design Patterns and SSH Architecture

2.1 Introduction to JavaEE Design Patterns

Design pattern[2] is from a higher level to describe the core structure of the program, so for many scenes are specific to general. In this paper, using the MVC pattern, Facade pattern and DAO mode.

2.2 Introduction to SSH Architecture

Struts is used to develop JSP and Servlet Web-tier application framework. It is an implementation of the MVC design pattern. In the Struts framework, Model on behalf of the application business logic; View is the application of said layer, produced by the JSP page; Controller provides control of the application process, generally Action Servlet. In this mode, the application logic, process and display logic is divided into different components, interaction between components and reuse. Hibernate is a Java environment for object / relational database (Object / RelationalMapping, ORM) mapping tool, Hibernate Java classes to not only manage the mapping database tables to provide data query and retrieval methods and lazy loading of data and other important functions, but also reduce the development time data using SQL and JDBC processing time, reducing the development effort [3]. Spring core container provides the basic functionality of the framework, the main component is Bean Factory, which uses Inversion of Control (IOC) mode, the application's configuration and dependency specification from the actual application code separate. Through the configuration management features, Spring AOP module directly to the object-oriented programming functionality into the Spring framework.

3 Functional Requirements and Overall System Architecture

3.1 Functional Requirements of Tourism E-Commerce System Has the Following Main Functions

Providing membership services and management functions, including member registration, member verification, membership information management; surveys and promotions, including online surveys, telephone, e-mail, electronic publications and other forms of travel for investigations and promotional activities; provide a strong, convenient, fast and personalized tour customized marketing function; to provide customers with safe, reliable and convenient online trading capabilities; offers order management functionality, including the review of customer orders, order inquiries and other functions; released book information function; released booking resources (hotel, tickets, merchandise and other information and price) information.

3.2 Overall System Architecture

Tourism e-commerce systems [3,4] is based on JavaEE platform Struts, Spring and Hibernate for development, both as a development tool MyEclipse7.0, MySQL database, Tomcat Web server. Framework (Figure 1) using an integrated strategy, had the responsibility of being included into view layer, business logic, data access layer, database layer of the four levels.

- view layer: It is responsible for processing data, including user and the system returns the data submitted. In this system the display layer is Struts + XSLT + XML to write;
- business logic layer: business logic dealing mainly with business logic and business rules defined between them, it is incumbent to show the benefits of layer provides business functions, does not interact directly with the database layer, but access to data through the data access layer . Meanwhile, ControlServlet by controlling the operation of the business logic, the operation results to the relevant users;
- Data Access Layer: mainly through the DAO pattern to complete the database access process;
- database layer: it is mainly in the data access layer data to be processed through the xml file into a specific data and store it into the database, and in the xml file is mainly defined entity classes and database tables one to one, many and many to many relationship. And the entity class and each attribute corresponds to the corresponding database table field.

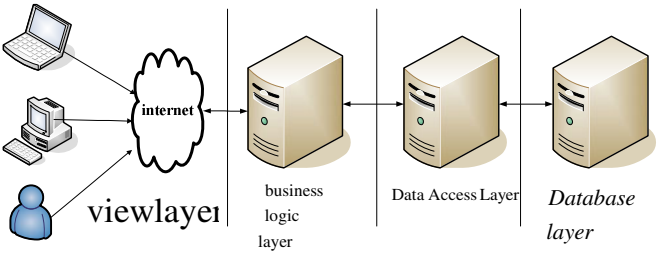

Fig. 1. Architecture of Tourism E-business System

4 System Architecture Design and Implementation

4.1 System Architecture Design

System calls through the interface between layers. Each has a clear mandate. And each exchange data through the interface, so, for each layer can be seen as an independent control. When the internal structure of each layer changes, simply modify the relevant interface implementation class and the interface remains stable, allowing the system to maintain minimum levels of inter-dependence, to achieve a loose coupling between layers, as shown in Figure 2.

4.2 System Architecture to Achieve [5]

4.2.1 MVC-Based Struts + XSLT + XML View Layer Implementation

① From Figure 2, we can see Controller receives a request from the browser, and decided where to send the request. This controller can be used to manage the navigation. Specific controller in Struts ActionServlet is achieved, which is the struts-config.xml configuration file request processing.

② With the Action class implements the business logic, action handling, steering link. Receives user requests, update the model and select the appropriate view of these components back to the user by the Struts controller components responsible, between model and view it in the schedule.

③ ActionForm class encapsulates the data and user interface elements.

④ View [6] is the XLST Servlet generates XML document according to Bean, and then call the XSLT to transform XML documents into HTML documents, and finally sent to the client browser. Its advantages are threefold: First, business logic and presentation logic to achieve the separation. Because XSLT file is used to transform XML documents into HTML form, if you want to change the browser view of the layout, you can only edit the XSLT file. Programmers to deal with more attention to business and art are on view, landscaping, the impact between them becomes very small; Second, the standard technical support, because XSLT uses the W3C standard language, so it can use the powerful tag library support; Third, XSLT can easily access a variety of output formats: plain text, HTML and many other XML format, not as HTML-like JSP center. This framework has a good scalability for multiple types of clients have provided good support.

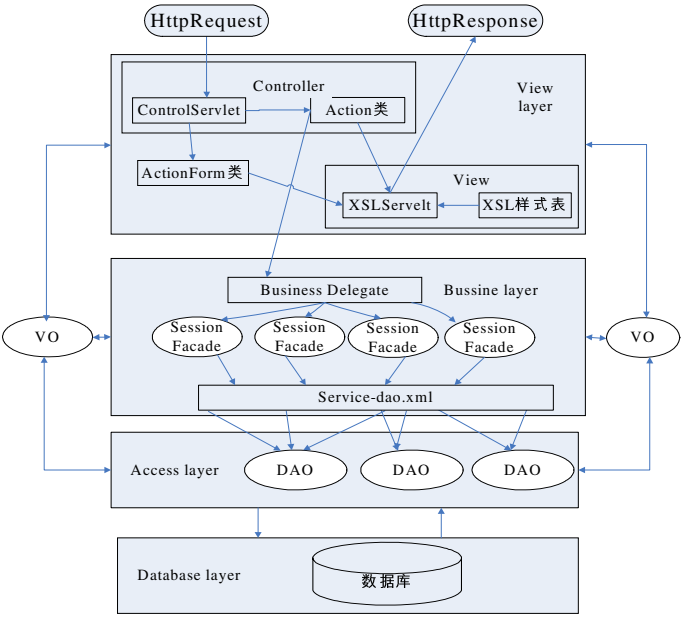

Fig. 2. Frameworkof Tourism E-business System

4.2.2 View Layer Implementation

Due to space limitations, here only given query sub-module of tourism products related to the page ProductSearchAction partial implementation class:

```
protected void process(ProductSearchForm form) {
ProductSearchVO uct=new ProductSearchVO();
//1、set ProductSearch fields from the form
//2、Call ProductSearchDelegate (ProductSearchVO uct) method;
//3、return mapping  page}
```

As can be seen from the above code, the data in the presentation layer that is FormBean, view layer to communicate with the business logic for the use of VO.

4.2.3 Implementation of Business Logic

4.2.3.1 Applied Business Delegate Pattern

From Figure 2, we can see that using the Business Delegate pattern can solve the client and tightly coupled business logic layer to avoid direct calls to the Action class Facade. Because Business Delegate Facade pattern can be used as window dressing, it encapsulates the business logic of the Action class visit. As provided in Section 4.2.2 of this system is a product query ProductSearchAction class, in its only visit in ProductSearchDelegate components in its management ProductSearchFaçade, because they maintain a one to one relationship, so that ProductSearchDelegate can all the methods available mapped to ProductSearchFaçade in, then ProductSearchAction class can be accessed directly through ProductSearch Delegate to ProductSearchFaçade. Benefit is effective in reducing the view of the coupling layer and business logic, and makes the system get stronger and increase the flexibility of the system maintainability. Also able to view the cache layer of the Action class information, which can improve the performance of httpRequest service request. Configuration file in part as follows:

```
<bean id="ProductSearchAction"
 class="com. tebs.action. ProductSearchAction " >
          <property name="ProductSearchFaçade"
      ref="ProductSearchFaçade" />
  </bean>
```

4.2.3.2 Facade Pattern Application

① From Figure 2, we can see Facade pattern to achieve a data access layer with weak coupling between the business logic layer. As in 4.2.3.2 in ProductSearchFaçade class through its access to service-dao.xml (mainly supported by the Spring framework) can be under the management of the Dao. The benefit of this is ProductSearchFaçade calling a specific DAO CRUD operations when the class is not it corresponds with the business logic components for communications, relationship and communication between them results only in ProductSearchfaçade class will occur after this has two advantages. One can reduce the network transmission times and improve system

performance; the other business logic and data access layer to reduce the coupling between.

② Reduce the formation of various Buessiness Delegate and Façade coupling components: because business logic is based on the classification of a key feature to divide it, each component is one or more packages Façade calls to each business service there is a clear service line.

③Convenient and secure transaction verification: Because façade class contains the data access layer that is operating in the DAO data CRUD, so you can focus on the façade of data validation and data security transaction. Configuration file in part as follows:

```
<bean id=" ProductSearchFaçade "
    class=" com. tebs. delegate. ProductSearchFaçadeImpl">
      <property name="ebsProcduct Dao"
          ref=" EbsProductDaoHibernate " />
  </bean>
```

4.2.4 Data Access Layer

Data Access Layer using Hibernate and Spring framework we, because we know that the DAO 4.2.3 main function is used to encapsulate database access process, which is the completion of specific VO class CRUD operations. By Hibernate and Spring framework can help us to accomplish two things: One is to achieve and the specific database-independent operation, and the second is the DAO pattern to achieve the specific data encapsulation particles, it can achieve a data source-independent data access and easy operation to achieve the data. Meanwhile, in order to maximize the reuse components, we use JDK6 available in generic technologies [6] for all DAO provides a generic interface to the parent (GenericDAO), then for Hibernate and Spring technologies to provide a generic implementation class (GenericJpaDAO), thereby reducing the amount of DAO mode programming code. Now the Product Management module (ebsProcduct), for example, specifically shown in Figure 3.

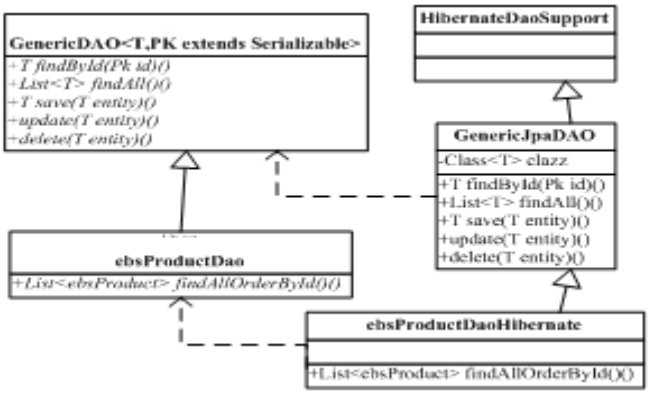

Fig. 3. Hotel management class diagram of the generic DAO pattern

```
  As follows:
  First, define a common generic DAO interface GenericDAO;
  Second, the abstract class GenericJpaDAO inherited
HibernateDaoSupport class implements GenericDAO
interface. By extending HibernateDaoSupport class, you
can get HibernateTemplate reference, but it encapsulates
the object domain of the CRUD operations. Such as:
  Public abstract class GenericaDaoJpa <T,PK extends
Serializable> extends HibernateDaoSupport {
    / / Define the clazz is through reflection to get the
actual binding of the current generic type (T.class).
Since Java Generics use swab and therefore can not be
directly through reflection to get T.class, but by
ParameterizedType object to obtain T.class,
implementation code slightly.
  private Class<T> clazz;
  ................
  public T findById(PK id){
  return (T) getHibernateTemplate().get(clazz,id)
  }
```

Third, the definition of ebsProcductDao interface extends the generic generic GenericDAO, which is defined as follows: public interface EbsProcductDAO extends GenericDAO <EbsProcduct, Integer> {} Finally, product management module of Hibernate DAO implementation class implements EbsProductDao EbsProduct-HibernateDao interface, and inherits the abstract class GenericHibernateDAO. This hotel management module Dao Hibernate implementation of the CRUD class EbsProductDaoHibernate would have a standard method, as defined as follows:

public class EbsProductDaoHibernate extends GenericHibernateDAO<ebsProduct, Integer > implements EbsProductDao {}

5 Conclusion

This JavaEE platform designed and implemented based on a variety of design patterns and improved lightweight SSH framework of tourism e-commerce systems framework. The system framework to follow industry standards, with scalable, high maintainability, security, performance, etc., which simplifies system programming code to improve software development efficiency, making the system on in the development of code quality has significantly increase, thereby greatly reducing the system development cycle.

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The Reform of Programming Teaching Based on Constructivism

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Abstract. Programming course is a challenging field of computer science for both to teach and learn. Constructivism is a world-wide known social-scientific theory, and its teaching theories become more and more popular. By the analysis for the characteristic of programming course and the exist problems in programming teaching, the reform programme of programming teaching based on constructivism is proposed. The idea and goal of reform, classroom teaching, practical link, and a constructivist extracurricular Assistant learning platform based on internet and so on are introduced. The last part is summation and vista of the paper.

Keywords: programming teaching, constructivism, reform programme, student-centered teaching, extracurricular Assistant learning platform.

1 Introduction

Programming is a method of visualizing abstract though, through which many skills, such as reading, judgment, analysis, abstract expression, and synthesis creation and so on, are all cultivated. As the core professional ability for the students of computer specialty, programming ability not only directly concerns the training of vocational skill, but also embodies the raise process of creative thinking and comprehensive quality. And since it is the basis for computer-related professional courses and has an important influence on the teaching quality of many following professional courses, programming course is listed as the core one by IEEE-CS/ACM and the official committee of the Chinese Ministry of Education on the teaching of computer science and technology respectively [1][2].

However, the teaching effect of programming is not very ideal, and the failure rate in final check and exam is higher. Some students exist misunderstanding to the key programming concepts and ideas and methods, and their programming style is irregular or/and lacks good teamwork spirit and communication capability. Moreover, Poor problem-solving ability greatly affects the learning of associated with many computer science courses.

"Computer programming is all fabricated that finds few parallels in the physical world..." [3], so, the novice programmer lacks the necessary base knowledge for comprehending programming concepts. On the other hand, the pedagogy adopted in

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programming teaching of many colleges is based on the objectivist theory, which view learning as the passive knowledge transmission process in which the teacher imparts his or her knowledge to the students. The above two aspects can be regarded as the main causes of failures in programming learning and teaching.

Constructivism is a theory of knowledge and learning, which states that knowledge is constructed rather than received from an objective world or external reality, and learning is the result of constructing meaning based on an individual's experience and prior knowledge in social interaction, within cultures, and through language. The pedagogy based on constructivism is student-centered, which places greater emphasis on learner's prior experience rather than the teacher's and on the active construction of knowledge rather than the passive receipt of information. Obviously, the constructivism pedagogy is more appropriate to resolve the problems encountered in programming teaching [4].

Based on the analysis above, the reform programme of programming teaching based on constructivism is proposed. First of all, the constructivism theory is reviewed. Then, the idea and goal of reform, classroom teaching, practical link, and a constructivist extracurricular learning platform and so on are introduced. The last part is summation and vista of the paper.

2 Constructivism Theory

Constructivism, which is based on psychology, is basically a theory about knowledge and learning. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and experience, maybe changing what we believe, or maybe discarding the new information as irrelevant. In any case, we are active creators of our own knowledge. To do this, we must ask questions, explore, and assess what we know.

Constructivism has been successfully applied to the field of education and formed some new pedagogic models, where the student should construct their own knowledge instead of passively absorbing it in a classroom or by consulting text books. This way of learning demands that the student not only discovers the facts, but also creates mental models from them that may result in knowledge construction. The task of supervising and stimulating the students in achieving this goal is assigned to the teacher, who must be simultaneously aware of the individual cognitive structures of all the students, which in turns makes the method pedagogically more complex than the classical instruction. Some pedagogical guidelines and strategies based on the constructivist theory are as following [5].

***Authentic learning tasks*:** Learning tasks should be embedded in problem solving contexts that are relevant in the real world. The tasks may be, for example, problem-based or case-based. These immerse the learner in a situation which requires the learner to acquire the knowledge and skills relevant to solving the problem.

***Interaction*:** Interaction is viewed as the primary source material for the cognitive constructions that people build to make sense of the world. Dialogue and the negotiation of meaning provide the basis for the individual to develop, test and refine their ideas. There are two main strands for developing interactive, social contexts for

learning. These strands focus on tutor- student relationships and peer group relationships respectively.

***Encourage voice and ownership in the Learning Process*:** Students should be allowed to choose the problems they will work on. Rather than the teacher acting as the taskmaster, the teacher should serve as a consultant to help students to generate problems which are relevant and interesting to them. It is argued that this is a vital part of solving problems in the real world.

***Experience with the knowledge construction process*:** The emphasis on authentic tasks and rich interaction provides a base for experience with the knowledge construction process. Conventionally the outcomes of the learning process would be defined in terms of the knowledge and skills the student has acquired. Constructivists argue that experiencing and becoming proficient in the process of constructing knowledge is more important. In other words it is learning how to learn, how to construct and refine new meaning that is most important.

***Metacognition*:** This is the ultimate goal of a constructivist approach. Problem solving involves the processes of reflecting on problems and searching for solutions. Metacognition is the higher order process of reflecting on our own thinking and problem solving processes. Metacognition has powerful problem solving potential. If we are stuck with a problem we can reflect not just on the structure of the problem, but on the structuring of our approaches to the problem. We can then try to generate alternative, more productive strategies.

These principles provide a guide for summarizing the constructivist proposals for the reform of programming teaching.

3 The Reform Programme of Programming Teaching Based on Constructivism

3.1 Reform Ideas and Goals

A useful concept for designing effective instruction is the taxonomy of learning objectives developed by Howard Bloom who identified five levels within the cognitive domain, from (i) knowledge recall at the lowest level, through increasingly more complex and abstract mental levels and intellectual skills: (ii) comprehending information and organizing ideas, (iii) applying knowledge and choosing among alternatives in problem-solving, (iv) analyzing and synthesizing data, and (v) evaluating ideas or actions [6]. This deeper level of understanding and the ability to flexibly apply knowledge should be the goal of programming instruction.

Under the taxonomy of learning objectives, a hierarchy of instruction goals should be fixed on in programming teaching. There are three types of knowledge needed for students which includes programming language syntax, programming concepts and ideas and methods, problem-specific knowledge. These knowledge type need to be closely related to each other in order to be useful for problem-solving. The most important problem-solving capability for building these knowledge are analysis capability, such as understanding, describing, refining, and representing problem situations, design capability, such as structuring, integrating, reusing, and combining

program modules, reflexive and critical thinking capability, such as evaluating, explaining, and justifying the solution process, as well as good teamwork spirit and communication capability. In addition, due to the rapid development of computer science, lifelong learning skills are becoming the important ability to remain current within the profession.

3.2 Reform of Classroom Teaching

The traditional methods of classroom teaching is based on objectivist and teacher-centered, and listening to lectures and reading books are the primary means of knowledge transmission. In the process of teaching, teacher usually neglects the prior knowledge, cultural backgrounds, mind status, and learning interest of students, meanwhile the students usually passively receive knowledge without engaging the mind appropriately to successfully tackle the programming paradigm. So, the traditional methods of classroom teaching can not reach deeper level in Bloom's Taxonomy and realize the reform goal above.

Under the constructivism theory, some mature teaching methods have been formed, among which the most popular ones are scaffolding instruction, anchored instruction and random access instruction.

Scaffolding instruction as a teaching strategy originates from Lev Vygotsky's sociocultural theory and his concept of the zone of proximal development (ZPD). "The zone of proximal development is the distance between what children can do by themselves and the next learning that they can be helped to achieve with competent assistance". In scaffolding instruction a more knowledgeable other provides scaffolds or supports to facilitate the learner's development. The scaffolds facilitate a student's ability to build on prior knowledge and internalize new information. The activities provided in scaffolding instruction are just beyond the level of what the learner can do alone. The more capable other provides the scaffolds so that the learner can accomplish (with assistance) the tasks that he or she could otherwise not complete, thus helping the learner through the ZPD [7].

Anchored instruction refers to instruction in which the material to be learned is presented in the context of an authentic event that serves to anchor or situate the material and, further, allows it to be examined from multiple perspectives. Principles of anchored instruction are in the following [8]:

Learning and teaching activities should be designed around an "anchor" which is often a story, adventure, or situation that includes a problem or issue to be dealt with that is of interest to the students.

Instructional materials should include rich resources students can explore as they try to decide how to solve a problem (e.g., interactive videodisc programs).

The central claim of Random Access Instruction is that revisiting the same material, at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives is essential for attaining the goals of advanced knowledge acquisition (mastery of complexity in understanding and preparation for transfer). Thus, instructional emphasis is placed upon the presentation of information from multiple perspectives and use of many case studies that present diverse examples. Principles of Random Access Instruction are in the following [9]:

Learning activities must provide multiple representations of content.

Instructional materials should avoid oversimplifying the content domain and support context-dependent knowledge.

Instruction should be case-based and emphasize knowledge construction, not transmission of information.

Knowledge sources should be highly interconnected rather than compartmentalized.

Although scaffolding instruction, anchored instruction and random access instruction are all mature teaching methods and all have good teaching effects, their characteristics and suitable scope are various. Comparatively speaking, scaffolding instruction is suitable to the situation that students learns the new concepts and systematic knowledge, and anchored instruction is suitable to the situation that students apply knowledge to solve problems, and random access instruction is used to break through difficulties and review. So in our reform of classroom teaching, we flexibly adopted different teaching methods according to different teaching content and goal of programming course.

For example, scaffolding instruction is adopted in introduction of the pointer concept, and anchored instruction is used in teaching process of bubble sorting methods. Since loop structure is quite complicated and its implement involves many problems, loop program design is the difficult point of programming teaching. So loop program design is especially well suited to random access instruction.

3.3 Reinforcement of Practical Teaching Link

Programming is a course with very strong practicality. There is no shortcut in learning to program, but extensive hands-on practice and sufficient time to become familiar with programming concepts is needed. In order to strengthen practical teaching link, a multi-form practical system, which consists of laboratory experiment and interest groups and programming contest, is constructed.

The laboratory experiment includes basic exercises and comprehensive experiment. In basic exercises, whose goals is to bring all students through levels(i) and (ii) and into level(iii) in Bloom's taxonomy, each student must complete 16 experiment projects for three kinds of topics which are debugging operations, programming and error correction. The comprehensive experiment aims at move students through level(iii) and (iv) and (v) of Bloom's taxonomy, that is to say, allowing them to apply knowledge to solve more complex problems, choose among alternative solutions, analyze and synthesize requirements, and evaluate their ideas or actions. I would like to emphasize that in comprehensive experiment students must work in groups to foster teamwork spirit and communication capability.

As an after-school activity, interest groups are mainly oriented to excellent students and aims at encouraging students to research and to do some cooperative study, such as the development of small-size software. The programming contest can greatly stimulate the motivation of programming among students, and provide an opportunity for many enthusiastic programmers to usher their abilities in analyzing and solving problems. For example, the International Collegiate Programming Contest (ACM/ICPC) is one of the most famous programming contest, and its scale and impact expands year after year in many colleges and universities all over the world. Teachers should encourage and organize students to take part in various programming contest including ACM/ICPC.

3.4 A constructivist Extracurricular Assistant Learning Platform Based on Internet

Internet forums have been a popular social web tool for many years. This has no doubt due to the communal nature of their design, and their simple and informative layout. It is then very quick and convenient for students to post work, discussions, links to texts, or anything they deem necessary for their peers to see. There is also the added benefit of forums being asynchronous to allow students to post and respond at any time they like to.

Blog, as valuable knowledge management and group communication tools, has captured the imagination of members of both the corporate world and education community. Blog are distributed, aggregated, open and independent. Through the use of blog, it is suggested that teachers and learners are becoming empowered, motivated, reflective and connected practitioners in new knowledge environments.

As non-linear, evolving, complex and networked texts with multiple authors, wikis can provide a great opportunity for student collaboration, co-production of texts, argument, and interaction. Most existing wikis systems are also flexible enough to support a variety of approaches for employing them in teaching, research, and academic administration and information settings.

Due to numerous merits above of blogs, wikis and forums, a constructivist assistant extracurricular learning platform is designed. As a kind of elementary form, it mainly collects and filtrates and neatens all kinds of internet resources of programming, including blogs, wikis, forums and some multimedia materials. This platform will help to improve the learning interest and enthusiasm of students, foster the cooperation and communication ability and lifelong learning skills, and increase the ability of gaining new knowledge using modern informatization tools.

3.5 Evaluation of Learning Achievement

The previous methods of evaluation of learning achievement mainly adopt the form of end-of-term theory examination. Because the emphasis of evaluation is the finishing results and not procedure, this method cannot comprehensively examine student's study level and ability of solving problem, also cannot efficiently stimulate student's study interest and power.

After reform, the new evaluation and assessment work is grouped into four components: class participation, labs, quizzes and exams. Class participation relates to preparation work completed, every class attended, and every activity in class. Labs involve lab preparation and report, lab results, and every activity in labs. Quizzes are given at the end of every major topic or book chapter. Exams include midterm and final. The new evaluation and assessment work combine the procedure check and results check and cover the 5 levels from Bloom’s taxonomy.

4 Conclusions

In this paper, the reform programme of programming teaching based on constructivism is presented. Although we have only been able to outline the reform programme in broader terms, we are convinced that constructivism theory offers a

potentially powerful way to improve the teaching quality of programming teaching comprehensively. We are now in the process of implementing the reform programme step by step and have won the initial success. The teaching reform needs a long-term effort, especially making constructivist reform. In future, we will improve our understanding of students' prior knowledge, refine and detail the reform programme, and upgrade the extracurricular assistant learning platform to embody constructivism theory and add new web2.0 tools.

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Galloping Region Division Method of Power Transmisson Lines Based on Galloping Mechanism

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Abstract. The power transmission lines galloping accidents, can easily lead to major economic losses and serious impact on people's lives. Reasonable division of galloping region for transmission lines ,can offer helpful reference and guidance to the design and construction of transmission lines ,so such disasters can be effectively avoided. However, the common method of galloping region division often gives just a rough division, which is difficult to be directly used for guiding engineering practice. This paper proposes a galloping region division method based on galloping mechanism. It takes into account a region's meteorological factors, geographic factors and the type of transmission lines. A series of galloping region division maps can be gotten by this method, to better guide the design and construction of transmission lines.

Keywords: transmission lines galloping, galloping mechanism, galloping region division.

1 Introduction

Galloping of transmission lines is a low frequency(0.1~3 Hz), high amplitude(5~100 times of transmission line's diameter, up to 10m) self-excited vibrations, which often occurs on iced conductors with non-circle cross-section. [1] The large amplitude , long time lasting wave-vibrations always caused flashover, tripping, support hardware damage, conductors burned, tower collapse and other serious accidents.

Therefore, it's necessary to prestent a detailed map of galloping region division, by understand the mechanism of conductor galloping, and combined with the region's specific meteorological factors, geographic factors and the parameters of transmission lines. The map will make great guiding significance to the transmission lines' planning, exploration, design, and the operation of grid security and stability.

2 Basic Theory of Conductor Galloping

The galloping mechanism of transmission lines is a complex intersection research topic of aerodynamics and structural dynamics, related to many factors.By now, the existend

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research results still have great limitations in fully and accurately explaining the phenomenon of galloping, especially in explaining the quantitative relationship of the reated various factors.

2.1 Galloping Mechanism

The earliest researcher of conductor galloping is Davison, who thinks the cause is this the periodic lift force generated by periodic torsion of conductors when galloping. [2] After him, there are endless theories about galloping mechanism. However, only two types of galloping mechanism has been widely accepted. One is the lateral instability excitation mechanism, proposed by Deng Hartog in1932, the other is the torsional mechanism by Nigol in 1972.

The Deng Hartog mechanism(also named lateral instability excitation mechanism) argued that the instable aerodynamic on the irregular sections of ice-coated conductor is the cause of galloping, while it is not necessary to need the torsion of conductors. The necessary condition for galloping is[3-4]

$$C_D + \partial C_L / \partial \alpha < 0 \tag{1}$$

Where, C_D is resistance coefficient, C_L is lift coefficient, α is wind attack angle and is $C_D + \partial C_L / \partial \alpha$ called Deng Hartog coefficient.

It means, the cause of galloping is that the sum of aerodynamic damping and mechanical damping is minus. It can be seen that the slope of lift coefficient curve corresponding to the initial wind attack angle must be minus.

Nigol mechanism (also called torsional vibration instability excitation mechanism) holds that when the ice on the conductors satisfies certain conditions, the wind attack angle will change periodically with the conductors' torsional vibration, then there will be a cyclical fluctuations in the conductor's lift force. When the frenquences of conductors' torsional vibration and that of transverse wind self-excited vibration are close, the conductor's lateral forced vibration will change into resonance. So, the lateral vibration excited by torsional vibration. The necessary condition for galloping is

$$\partial C_M / \partial \alpha < 0 \tag{2}$$

Where, C_M is the torque coefficient of conductor, and $\partial C_M / \partial \alpha$ is Nigol coefficient.

A three-degree-of-freedom model can be formulated by comprehensive consideration of the conductor's along-wind, across-wind and torsional vibration. The equations are as follows,

$$m\frac{d^2y}{dt^2} + \left(K_1 + \frac{L_1 + D_0}{V}\right)\frac{dy}{dt} + T\left(\frac{n\pi}{L}\right)^2 y = -m_i r\cos\theta_0 \frac{d^2\theta}{dt^2} + L_1\theta + \frac{2L_0}{V}\frac{dx}{dt} \tag{3}$$

$$m\frac{d^2x}{dt^2} + \left(K_2 + \frac{2D_0}{V}\right)\frac{dx}{dt} + T\left(\frac{n\pi}{L}\right)^2 x = -m_i r\sin\theta_0 \frac{d^2\theta}{dt^2} + D_1\theta + \frac{L_0 - D_1}{V}\frac{dy}{dt} \tag{4}$$

$$J\frac{d^2\theta}{dt^2} + (K_3 + M_2)\frac{d\theta}{dt} + \left[s\left(\frac{n\pi}{L}\right)^2 - M_1 - m_i r g\sin\theta_0\right]\theta = -m_i r\cos\theta_0 \frac{d^2y}{dt^2} - \frac{M_2}{V}\frac{dy}{dt} - m_i r\sin\theta_0 \frac{d^2x}{dt^2} - \frac{2M_0}{V}\frac{dx}{dt} \tag{5}$$

Where, K1、K2、K are the damping in the along-wind, across-wind and torsional directions respectively. D0、D_1 are resistance and its first derivative, L0、L1 are lift force and its first derivative, M_2 is torsional aerodynamic damping, V is wind speed, s is torsional stiffness, T is conductor's tension, m_i is unit length mass of ice on the conductor, m is the unit length mass of conductor, θ_0 is initial wind attack angle, θ is wind attack angle, r is conductor's radius, n is the vibration order, and L is the span length.

2.2 The Influencing Factors of Galloping

According to the expressions of Deng Hartog mechanism and Nigol mechanism, it can be seen that there are many factors that affect the conductor galloping, and their interaction mechanism is also extremely complex. But in general these factors can be divided into three categories, namely wind excitation, ice, and parameters of line structure[1]. Aaccident statistics is also consistent with the above analysis.

(1) Wind Excitation

The wind excitation is mainly determined by wind direction (which determines the wind attack angle)and wind velocity. As conductor's galloping is the combined effects of wind and ice, wind excitation commonly referres to the excitation on the ice adhering on the conductor.

For the same transmission line, wind speed and wind direction (wind attack angle)are the most critical factors affecting conductor galloping, when other meteorological factors remains unchanged. This is besause wind direction and wind speed affect the formation of irregular ice cross-section on the conductor surface, and the aerodynamic characteristics of conductors is determined by the cross-section shape and wind attack angle. When the wind attack angle, ice cross-section shape and wind speed meet certain conditions , galloping occurs.

When icing conditions (i.e. the temperature and humidity and other weather conditions) are met, the certain wind speed, in a range of 0 - 2 m/s, is most conducive to the formation of ice [7] . After the formation of uneven ice, the conductors are prone to galloping, in a wind speed range of 4 - 20 m/s , and the angle between wind and transmission lines ≥45°. The angle between wind and transmission lines our country in the range of 45° -90° accounted for about 94.6%, in China's conductor galloping cases[8].

The 276 sets of data provided by Dashanbao ice-coated watching station, at an altitude of 3119.6 m in Zhaotong of Yunnan provience, shows that when the wind direction is perpendicular to the line, the ice thickness ratio increased 1.2-2.0 times, in an average of 1.523 times, than that of when the wind is parallel to the line. The statistics fullly demonstrated the impact of wind direction on the formation of ice and conductor galloping[7].

These cases verified the influence of wind excitation on conductor's galloping in Deng Hartog mechanism and Nigol mechanism.

(2) The Influence of Ice on the Conductors

It can be seen from the 3 d.o.f. model that the impact of ice on the galloping works by changing torsional aerodynamic damping M_2, wind attack angleθ, unit length mass of ice on the conductor m_i.

The irregular ice sections on the conductor cause aerodynamic instability by wind excitation, which leads to torsional vibration and lateral vibration of conductors. When they meet the Nigol mechanism, strong galloping happens.

Statistics shows that the most typical and representative ice thickness is 3-20 mm, mainly on the windward side of the conductor, a crescentiform, when galloping happens. In other cases, the ice shape is approximately round.

As can be seen from the above, the formation of ice is closely related to the local overall meteorological factors and geographical conditions in different areas. While in one area, micro-geographical conditions and other micro-meteorological factors, such as lakes, watershed, and valley terrain, are further affected the formation of ice in a specific line. So it's necessary to take the meteorological factors and geographical conditions into consideration when dividing galloping regions.

(3) The Structure and Parameters of Transmission Lines

It can be seen from the formulaes (3)-(5) that, the torsional stiffness s, conductor's tension T, the unit length mass of conductor m, conductor's radius r, and the span length L,are all determined by the structure and parameters of transmission lines, which directly affect the formation of galloping. So, several conclusions can be gotten from the formulaes.

The bundle conductors are prone to gallop than single conductors.This is because that the ice on the conductors is usually eccentric, then the eccentric quality is bound to cause the conductors to twist. For the small torsional stiffness s of single conductors, the eccentric ice will turn into round shape due to the torsion of the single conductors. While the extremely ,with small torsion of bundle conductors due to their high torsional stiffness, cause significantly eccentric ice shape, which makes it's easier to gallop. A variety of statistics and references also proved the above analysis[10].

Besides, the conductor's radius also has impact on the galloping by affecting the ice thickness. At a wind speed scope of $V<8$m/s, the ice become thicker with the increase of the diameter of conductors when $d<40$mm and thinner when $d>40$mm. While at the wind speed scope of $V>8$m/s, the ice become thinner with the increase of the diameter of conductors.

Meanwhile, the ice on live wire is thicker than that of not live wire, due to the electric field's adsorption ability of small water droplets. The observational data of two 110kV transmission lines, less than 1000m away from each other in Jingzhou, Hubei provience, in the winter of 1989, show that the ice diameter on the live one is 7.5mm thicker than that of the not live one.

3 Galloping Region Division Methods

In recent years, various research institutes and universities have tried to divide galloping regions of transmission lines from different angles, in order to guide the rational planning of the power design department to design new transmission lines, and facilitate the maintenance of built lines, design appropriate anti-galloping devices, and to take reasonable measures to prevent galloping. This paper will take the galloping mechanism into consideration when dividing galloping regions.

3.1 The Significance of Galloping Region Division

Rational galloping region division can not only prevent tripping, fittings damage, tower collapse and other major accidents, to reduce unnecessary economic losses, but also can save a lot of money and resources for the government and companies.

According to historical records, a 110kV transmission line,designed on the basis of light ice region standard, in 1961, Yunnan provience, resulted in the actual ice thickness 4 times of the design thickness, which led to cross arm broken accidents and Kunming's power failure ,for failing to consider the micro-geographical conditions and other micro- meteorological factors in the Hawks Mountain area (heavy ice area).

In contrast to this, a total savings of about $ 7 million investment in infrastructure is saved for a design change of revising design ice thickness 30mm (extremely heavy ice standard) to 20mm in the watershed location (heavy ice standard), in a 220kV transmission lines across Northeast Yunnan, Zhaotong, by identification of well-known weather experts[7].

3.2 Analysis of Galloping Region Division Methods

As the significance of galloping divisions, engineers and academia have explored a variety of different galloping area division methods. One of the most common method is to divide the whole region into different levels of meteorological areas in accordance with meteorological elements.

This approach lists the related meteorological factors first, distribute their weights based on their scope, change magnitude, and the importance to ice cover, and then superimposed and classified. Or, for randomness and ambiguity of weather conditions on the effects of conductor galloping, galloping regions can be divided by considering the use of intersection theory of automatic control theory and the theory of optimization research --- gray cluster analysis[12]. These meteorological factors include the average winter minimum temperature, common wind direction and wind speed, glaze, frost, rime, the amount of average daily temperature, and air humidity. Generally speaking, a typical region can be divided into six levels ,that is ice-free area, light ice area, ice area, heavy ice area, especially ice area and extremely heavy ice, by these methods.

This approach only considers meteorological factors, so it is simple,and has a certain significance. However, its disadvantages are also obvious: ① neglecting the specific structure and parameters of transmission lines, apparently the same area the same weather conditions, the wire of a certain votage level will gallop, and the wires of other levels may not gallop. ② Not taking into account the micro-meteorology, and micro-topography elements that can not be ignored. Because the permanent meteorological stations are usually set around the cities, which does not reflect the canyon, air, mountains, watersheds and other local micro-meteorological conditions of the actual terrain points along the lines. ③ At present, China is still lack of ice observational data of over 10 years, so the limitation of available meteorological data also undermine the credibility of the results of the division.

Another division method is to divide the lines with similar number of galloping in a same time period into one galloping region, by counting the observational records of built lines [13]. This method only applies to the constructed lines' galloping zoning, and is with a lag, not suitable to guide new transmission lines's planning and design.

Besides,the domestic observational data of the conductor galloping is very limited. Therefore, in practice, this method can be used with the weather division approach, and to correct the meteorological divisions.

3.3 Galloping Region Division Method Based on Galloping Mechanism

This paper proposes a galloping area division method based on galloping area mechanism, for the significance of alloping area division and the limitations of the above two classification methods.

It's known from the galloping mechanism, that galloping is the joint result of meteorological and geographical factors, and specific transmission lines parameters.

Different types of wire conductors have different parameters ,such as single conductor or bundle conductors, voltage level, wire radius r, torsional stiffness s, torsional vibration frequency f, the conductor mass per unit length m, wire tension T and wire suspension height. By Deng Hatto mechanism and Nigol mechanism, it can be seen that even geographical factors and climatic factors are the same, there are differences in the ice thickness and shape on the wire, and its response to the same wind excitation, which will inevitably lead to the failure of aforementioned galloping area classification method based on meteorological factors. Therefore, the zoning of galloping must take the specific wire type into consideration.

Therefore, the specific structural parameters of different types of wire must be considered during the conductor galloping zoning, with meteorological and geographical factors, and substituted the three degrees of freedom vibration model for modeling and simulation.Then, by the use of reverse project, galloping maps of different types of wire are established.

Specific steps of this method are as follows:

1) Divide the areas into an initial weather zoning draft, by comprehensive collection, statistics, sorting and classification of the meteorological factors data associated with the conductor galloping in the region since the earliest meteorological records.

2) Consider the micro-topography, micro-meteorological effects, to amend the sketch in step 1), and get the final version of the weather division zoning map .

3) Substitute the specific structural parameters of a certain type of wire into the three degrees of freedom vibration model for modeling and simulation, and then a skecch of galloping region about the specific type of wire can be gotten based on the drawing of step 2).

4) Revise the draft in 3), by comprehensively collecting the operating experience and data of the electric power lines and communication lines in the region and nearby areas, to get the final galloping region map of the specific type of wire.

5) Verify that the design of existing transmission lines meets the standards and requirements of local galloping region. if not satisfied, it need to take effective measures to prevent galloping, for example, to install anti-galloping device. The choose another type of wire to cycle from step 3).

6) Draw different types of wire's galloping maps in the region successively, and compile them into tool books based on wire types for the electric design and construction departments.

The innovation of this method is to change the "one size fits all" type of weather zoning map in the past, which considers the meteorological factors only, without considering the specific form of wire. This method amends the basic meteorological maps, by substitute the specific structural parameters of a certain type of wire into the three degrees of freedom vibration model for modeling and simulation, and then get several specific maps of galloping region, and compile them together.The maps can not only guide anti-galloping measures to strengthen existing lines, can also guide the design and construction of new transmission lines. It makes the galloping region maps specific and targeted, with significance of practical engineering guidance.

4 Conclusion

This paper proposes a galloping region division method based on galloping mechanism, which takes into account the meteorological factors, geographic factors and specific characteristics of transmission lines in a region. By the successive amending of galloping region division drafts, we can get a galloping division map of the certain type of wire in a region, and then a series of galloping division maps can be gotten by changing the types of wire using the same method.

However, the widely use and popularization of this method still rely on the accumulation and access of more comprehensive weather information and geographic data, and parameters of transmission lines.So it's a long term job which need the cooperation and communication of meteorological department, geological department and power design department in the future.

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A Kind of Mechanism Based Agent Model Design*

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Abstract. In agent-based complex adaptive system modeling and simulation, Agent is often situated in dynamic environment, so in order to reflect the fundamental characteristic of Agent - autonomy, it is necessary to describe the learning ability and adaptability that how Agent makes adaptive change autonomously with the change of environment. However, current researches on Agent model achieve the Agent's external intelligence attributes through a static model structure. Few research studies the internal reason of its intelligence---Agent's learning ability and adaptability. This paper introduces the concept of mechanism to describe Agent's dynamic properties of ongoing adaptation and learning, and to study the establishment and design of Agent model based on mechanism.

Keywords: Agent, Complex adaptive system, adaptability, model, mechanism.

1 Introduction

In Agent-based complex adaptive system modeling and simulation, the goal is to simulate the complex phenomenon of complex adaptive rather than solve problems in multi-Agent system of ordinary artificial intelligence. Therefore, in Agent-based complex adaptive system modeling and simulation, the design of Agent model structure is the most complex and most important part.

On Agent, at present there is no universally accepted definition of academia yet. It is generally believed that, if a system has the following characteristics: autonomy, reactivity, pro-activity and social ability, it can be called as Agent, in which autonomy is the most striking feature of Agent [1].

In the early researches on Agent model structure, people emphasized to design complex emergence phenomena with a simple Agent structure. Thus, in the modeling process people often remain a principle known as KISS (Keep It Simple and Stupid). The recent study shows that: over-simplify the Agent structure model is not conducive to the further development of Agent-based modeling and simulation. Edmonds and Moss [2] has proposed KIDS (Keep It Descriptive Stupid) principle,

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which points out that people can give Agent more ability to illustrate problems. Therefore, more and more people suggest that people should study the Agent structure which has the ability to imitate decision-making processes of real human beings. Claudia and Ebenoth [3] presented a way to establish Agent model through extracting experimental data of the real economy and apply then model into social simulation. Sun and Naveh [4] studied a kind of organizational decision-making model based on the actual cognition process of human.

At present, among domestic and foreign literature, there are three main structures of Agent model: it is usually divided into deliberative Agent, reactive Agent and hybrid Agent [5-6]. However, the existing three Agent models are all extrinsic intelligent attributes of Agent achieved based on the static structure of Agent. Few research studies the internal reason of its intelligence---Agent's learning ability and adaptability.

Generally speaking, in Agent-based complex adaptive system modeling and simulation, Agent is often situated in dynamic environment, so in order to reflect the fundamental characteristic of Agent - autonomy, it is necessary to describe the learning ability and adaptability that how Agent makes adaptive change autonomously with the change of environment. This paper introduces the concept of mechanism to describe Agent's dynamic properties of ongoing adaptation and learning, and consider the intelligent attributes emerging in Agent's ongoing adaption and evolution process as a mechanism for dynamic Agent to study the establishment and design of Agent model based on mechanism.

2 Relative Concepts of Mechanism

Definition 2.1: Mechanism can be seen as an internal model, which consists of the input signal, state (output signal) and the transfer function. It is a functional structure model emerged dynamically by the interaction of low-level mechanism. The so-called dynamic construction of mechanism refers to the transfer function of mechanism is constructed dynamically. Mechanism can be used as building blocks for further interaction with other building blocks, and then emerge a higher level mechanism. The bottom mechanism is called meta-mechanism which is composed of a certain rule of Agent mechanism and its associated input and output state. Mechanism possesses structural, hierarchical, functional and emergent property.

1. Structural: Structural property of mechanism is to consider the mechanism as a structure model of dynamic mechanism connection or aggregation that constructed by the interaction of low-level mechanism.

2. Hierarchical: it takes a number of relatively simple mechanisms as building blocks to form a higher level mechanism. Therefore, the complexity of Agent mechanism often doesn't lie in the number and size of mechanism but in the realignment of the original mechanisms.

3. Functional: as an internal model, mechanism often has certain features that it can make perception, cognition, reaction, calculation and operation on environment signal.

4. Emergent: as an internal model, mechanism is generated dynamically, and its overall function is greater than the sum of partial functions.

Suppose that the transfer function of mechanism M is f, the aggregate of mechanism states is S = (S_1, S_2, S_3 ...), and the aggregate of input signal is I = (I_1, I_2 ... I_K). Thus, the mechanism transfer function (rules) f can be defined as: I x S → S that is: f: (I_1 x I2, x ... x IK) x S → S. Take input signal value of the current mechanism and the current state as the initial parameters of mechanism transfer function, and then next state of the mechanism can be generated. Therefore, formal description of mechanism M is:

$$M::=<Mid , I , f , S>$$

Mid refers to the identification of mechanism; I is the aggregate of input signal; f is transfer function of mechanism; S is the aggregate of mechanism states.

Definition 2.2: Signals refer to those messages that can be transmitted in the mechanism and cause changes of system state.

Signal includes two forms. One form is standard signal that composed by binary string. The other one is information signal which is composed of specific information. Therefore, the formal description of signal can be expressed as:

NorSignal::=< SigiD , Dest , Source , SigType, Content , Infoflag >

SigiD is identification of signal, which is used to identify a signal uniquely; Dest and Source are receiving mechanism and delivery mechanism of signal; SigType is the signal type which shows that it is standard signal or information signal; Content is the signal content; Infoflag the identification bit of information signal, if it is 0, it means that there is no information signal behind it, while if a certain value, it refers to the identification of rare information signal.

3 Agent Model Structure Based on Mechanism

3.1 Agent Model Framework Based on Mechanism

As shown in Figure 3.1, in Agent model framework based on mechanism, consider Agent model as a dynamic mechanism that constructed by interaction between 4 basic mechanisms. The 4 basic mechanisms are basic perception mechanism P, basic operation mechanism A, basic decision-making mechanism D, basic adaptive control mechanism AC. Agent mechanism of these basic mechanisms are the meta-mechanisms of Agent model, and they are constructed dynamically by activated rules and the corresponding input and output state.

In Agent mechanism, the basic perception mechanism P is the basic input mechanism of Agent, and its main function is to make perception and classification on those environmental input signals, and give all kinds of input signals emotion coefficient. Emotion coefficient shows Agent's different concerns degree of various input signals, which can be used to represent the different values of emotion with natural numbers. The greater the emotion coefficient, that is, the higher the value, the greater concerns about signals of Agent mechanism, the higher the positive emotions. Suppose emotional parameter is K. When the emotion coefficient is equal to K, it refers to neutral emotions, when emotion coefficient is less than K, it is negative emotions, while when emotion coefficient is more than K, and it is positive emotions. Generally speaking, the basic perception mechanisms in Agent mechanism only can perceive input signals whose emotion coefficients are greater than or equal to emotion parameters K.

Basic operation mechanism of Agent is the basic output mechanism in Agent mechanism. Its main function is to construct corresponding dynamic transfer function for determine how to operate on external environment resources according to its current state and output signal that comes from basic decision-making mechanism.

Basic decision-making mechanism D describes the decision-making process of Agent mechanism. It corresponds to the decision-making logic of Agent mechanism from perception to operation.

Basic adaptive control mechanism AC is primary used to control the adaption and evolution process of different rules of other basic mechanisms in Agent mechanism. Adaptation refers to the action that other basic mechanisms change their transfer functions through learning and obtaining experience.

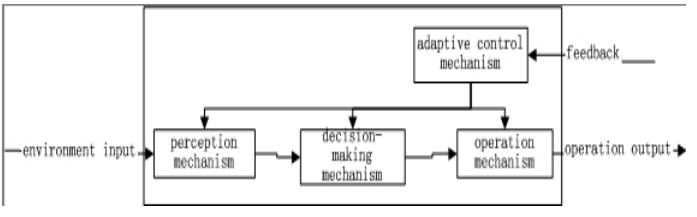

Fig. 1. Agent model structure based on mechanism

According to the definition of mechanism, the formal description of Agent mechanism model can be expressed as:

$$Ag::=< Aid , AI , AM , AS>$$

Ag is Agent mechanism; Aid is the identity of Agent mechanism; AI is the set of input signals which is expressed by the binary string, that is, composed of set (0,1, #) L, in which L is the length of binary string, # means that any string can be received in this position; AM refers to the transfer function constructed dynamically by interaction of 4 basic mechanisms; AS is the state of Agent , and it can be expressed by a set of output signals of Agent mechanism.

The formal description of AM is:

$$AM::=< Pf , Af , Df , Acf , £ >$$

Pf refers to the dynamic transfer function that constructed by activated rules in basic perception mechanism in Agent mechanism; Af refers to the dynamic transfer function that constructed by activated rules in basic operation mechanism; Df refers to the dynamic transfer function that constructed by activated rules in basic decision-making mechanism; Acf refers to the dynamic transfer function that constructed by activated rules in basic adaptive control mechanism; £ refers to parameters of interaction of four major basic mechanisms.

3.2 System Structure Design of Basic Mechanisms

In Agent mechanism, system structure of its basic mechanism includes the following elements:

$$BASIC\_S::=< BSI , BSR , BSpara , Bsproc, BSac >$$

BASIC _S signifies the system structure of basic mechanism; BSI signifies the current signal table of the basic mechanism; BSR signifies the current rule list of the basic mechanism; BSpara signifies rule parameter index table of the basic mechanisms that; BSproc signifies the implementation index table of the basic mechanism; BSac signifies the emotion coefficient correspondence table of input signal.

In basic mechanism, all input signals should be stored into current signal table to show the existing standard signal and information signal of basic mechanism. All rules are stored in its internal current rule list, and each rule has a corresponding credit which is assigned by corresponding adaptation evolution rules in basic mechanism according to credit dispatching algorithm under the control of the basic adaptive control mechanism.

3.3 Processing Flow of the Basic Mechanism

The input signal of basic mechanism has three sources. First of all, the input signal is from the external environment. After receiving this signal, basic perception mechanism give different utility to input environmental signals according to dynamically constructed transfer functions in order to collect a subset of certain environment state, and then generate perception signals of external environment. By receiving feedback signals from the external environment, basic adaptive control mechanism evaluates its internal adaptive control rules for controlling adaptive learning and evolution of other basic mechanisms. Second, output signals of basic perception mechanisms and basic decision-making mechanisms can be used as input signals of basic decision-making mechanism and basic operation mechanism. Third, it is adaptive control signal output by internal basic adaptive control mechanism. When receive this signal, basic perception mechanism, basic decision-making mechanism and basic operation mechanism activate their internal adaptive evolution rules to conduct credit allocation and adaptive evolution for corresponding rules.

The specific processing flow is: Basic mechanisms receive input signals and query its current rules list in accordance with these signals to check if there are rules which meet the input conditions. When the input signal meet input conditions of rules which is in current rules list of basic mechanism, the corresponding rules will be activated. Moreover, in the current rules list, input signals meeting the input conditions of rules, activated rules, and the corresponding output signals activating rules, the three elements constitute a dynamic basic mechanism. In general, at some point, many rules of the basic mechanism will be activated, and these activated rules are redundant or contradictory, therefore, at some point, many redundant or contradictory dynamic basic mechanisms will emerge at the same time.

When rules of basic mechanisms are activated, basic mechanisms need to first determine activated rules are basic rules or adaptive evolution rules of basic mechanisms. If the activated rules are basic rules, then implement the corresponding process of these basic rules. In basic perception mechanism, apart from the above operations, there is need to give corresponding emotion coefficient to input signals of activated perception rules. Then, basic mechanisms compete with each other and determine the construction of transfer function of basic mechanism in accordance with the credit of their activated basic rules, furthermore, basic perception mechanism

also needs to consider input signals' emotion coefficient of its activated rules. Finally, the dynamic transfer function generates corresponding output standard signal and information signal. In addition, output signals of this transfer function are used as perception output signal of basic mechanism. If the activated rules are adaptive evolution rules, then implement the corresponding adaptive evolution control process and allocate credit for rules or generate new rules; at the same time, make corresponding adjustment on input signals' emotion coefficients of perception rules in basic perception mechanism.

4 Conclusion

By introducing the concept of mechanism for Agent model, this paper can use dynamic Agent mechanism not static to describe Agent's intelligent attributes and adaptive ability in ongoing adaption and evolution process. In the past, Agent model structure use static control structure and complex algorithms to describe its intellectual property, which is inflexible and possess no adaptive ability and reusability. However, dynamic mechanism-based Agent model structure overcomes these shortcomings. Instead, the static structure of Agent is only used as a carrier for describing intelligent property, and let basic mechanisms of Agent construct dynamic structural model to describe a variety of intelligent property through bottom-up interaction of basic mechanisms. Thus, Agent model will be more flexible and it is easier to describe Agent's adaptive learning ability.

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The Implementation and Analysis of Fast Median Filter Based on FPGA

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Abstract. Median filter is a popular image preprocessing way; it can inevitably introduce various noises and make image quality become bad in the process of image generation, collection and transmission. So we have to make a preprocessing procedure to restraint the image noise for the following process. Because median filter is a kind of nonlinear filtering, in practice, it may overcome the image details blurring comparing with a linear filter and can effectively filter the pulse interference and image scanning noise. But, as the large computational complexity, the image preprocessing is slow with software method. Alternatively, we can use hardware method to help the preprocessing. The field programmable gate array (FPGA) is the programmable component based on the list structure. It has abundant registers resources and can change logic function through the reconfiguration, which makes the flexibility of design increase greatly. In this paper, we adopt FPGA platform to achieve mid-value filtering algorithm through VHDL hardware describe language. In the condition of possibly using hardware resources, through improving the algorithm and optimizing the structure, it efficiently digs up the inner parallelism of algorithm and increases processing speed of filtering module. We adopt a quick median filtering algorithm and the algorithm can greatly save the hardware resources, so the data processing speed is quick.

Keywords: Image Processing, Median Filter, FPGA, VHDL.

1 Introduction

The introducing of noise is inevitable in the processes of image generation, transmission, detection and processing, which overlaps with the original signal and resulting in a severe distortion of the image quality [1]. It also has an unpredictable effect to processes such as image division, feature extraction, image recognition et al. Unlike the blurring in mean filter, median filter can retain the edge details of the image while removing the impulse noise and the salt and pepper noise, and so can

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greatly overcome the image detail fuzzy problem. Moreover, median filtering algorithm is simple and feasible and is widely used in image processing [2].

The principle of traditional median filtering is to find out the median by using foam-forming method to order the pixels in the filter window [3,4]. However, the practicability of this algorithm is restricted by the huge amount of data to be processed, the limited hardware performance of a common platform and the inherent limitations of the algorithm itself, such as its slow ordering speed and long time delay. Therefore it is unsuitable for a quickly, real-time image processing. Through investigation, we find that the improved filtering algorithm based on FPGA parallel platforms can simplify the processing steps and accelerate the processing speed, and can realize a quick and real time image processing.

2 Fast Median Filtering Algorithm

Sorting is the core of the median filter algorithm. The quality of the sorting algorithm determines the efficiency of the value calculating directly, and so it determines the overall performance of the filter. In reference 5, combined with the characteristics of FPGA devices, a corresponding improvement algorithm is proposed .In the algorithm, the use of parallel processing and pipeline design ideas avoid a large number of comparison operations. Compared with the traditional median filter algorithm, the operation complexity is greatly reduced. So its processing speed of the image data is faster than the traditional median filtering algorithm.

Taking a 3×3 mask window as an example, the fast median filter algorithm is described as follows.

First, sort the gray value of the pixel in the window in descending order according to the column.

Second, sort the obtained sequence of window in descending order according to the row.

Third, output the median of the pixels on the diagonal.

In the traditional algorithm, 30 times comparison operations will be processed while 9 times in the improved algorithm (considering parallel processing). The fast improvement algorithm realizes the median filter on the basis of reducing the computation as much as possible, and so it makes the algorithm realized on the FPGA saving more hardware resources and computing cycles than the traditional median filter algorithm.

3 Algorithm Realizations

Fast median filtering is implemented using VHDL in the MaxpluII10.1 developed by Altera Corporation And the FPGA device employed is EP1K30TC144-3 of series ACEX1K, which is also developed by Altera Corporation. The program design is divided into four modules, including data input, descending ordering in columns, descending ordering in rows and calculating and outputting the median.

3.1 Data Reading

For a 3×3 filtering window, data is updated in turn based on 3bits bus. The principle of the data input is shown in Fig.1.

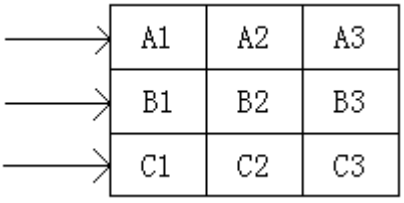

Fig. 1. Functional block diagram of date input

Data is fed into port A1, B1 and C1 in parallel way. Then under the control of clock, they followed in the paths of A1→A2→A3, B1→B2→B3 and C1→C2→C3 The initialization of the 3×3 median filtering window is accomplished after the first three data input, and the following data can be directly read and updated.

3.2 Sorting and Outputting

According to the principle of the algorithm, firstly, the input data is required to be sorted in descending order by rows, that is, sorting the first row of a1, b1, c1, the second row of a2, b2, c2 and the third row of a3, b3, c3 in descending order separately and get lmax1, lmed1, lmin1, lmax2, lmed2, lmin2, lmax3, lmed3 and lmin3, in which lmax1 refers to the max, lmed1 the median and lmin1 the minimum of the first row. And the other rows are similar.

After row sorting, the data still needs to be sorted in descending order by columns. The method is similar with row ordering except for the data we needed are only the median on the diagonal, so we only need to order the data on the diagonal line of the window and get three final outputs: the minimum of column1 (hmin1), the median of column2 (hmed2) and the max of column3 (hmax3). The simulation results are shown in Fig.2.

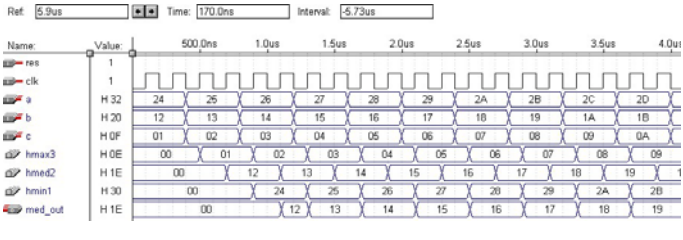

Fig. 2. Simulation Result

According to the simulation results in fig. 2, after column sorting, the median of the data on the diagonal line (hmin1, hmed2 and hmax3) is picked out and outputted. It is also the exact median of the whole 3×3 filtering window and is used to realize correctly the design of the median filtering algorithm.

4 Simulations and Results Analysis

The guiding ideology of the algorithm used here does not refer to sorting the values of all the pixels in the entire neighborhood window, but to find out the maximum, minimum and intermediate values directly regardless of the order of other pixel values. Compared with the traditional method, this method can reduce the occupancy of logic resources, but has the same effects with the traditional algorithm.

According to the time delay characteristic matrix of algorithm simulation, the maximal time delay of the data output relative to the system master clock is 11.7ns, which could meet the quick data processing need with a speed of 85MHz. The analysis report about chip resources shows that 26 input pins and 8 output pins are occupied, in which 6 of the input pins are dedicated and the rest 28 pins are regular I/O pins. 719 logical cells out of 1728 ones are occupied and the occupying rate is 41%. The more detailed results are shown in Fig.3.

Total dedicated input pins used:	6/6	(100%)
Total I/O pins used:	28/96	(29%)
Total logic cells used:	719/1728	(41%)
Total embedded cells used:	0/96	(0%)
Total EABs used:	0/6	(0%)
Average fan-in:	3.15/4	(78%)
Total fan-in:	2269/6912	(32%)

Fig. 3. Analysis of chip resources

5 Conclusions

In this paper, we applied an improved algorithm for computing the 3×3 filtering window's median value. By taking advantages of both the features of 3×3 window together with its fast computing method and the parallel performance of the FPGA, in the 3 level parallel sorting processing, we make each group of input pixel data being processed within every clock period therefore accelerating the processing speed of the module. The algorithm is realized on the FPGA hardware platforms. Compared with the software method, not only the image can be processed with high-speed, but the system hardware structure has such advantages of simplicity, high integration, strong reliability, fixed timing, short time delay and predictability. The programmable features of FPGA increase the flexibility of the system. With slight modification, the system can be used in different conditions. So it has a strong adaptability.

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A Current Sharing Strategy of Paralleled DC-DC Converter Based on Efficiency

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Abstract. For improving energy availability of a power system consisting of paralleled DC-DC converters, high operation efficiency ought to be maintained possibly. According to the efficiency characteristic of DC-DC converter, a current sharing strategy of paralleled converter based on efficiency was presented in this paper. When load changed, the converter modules number paralleled was adjusted, and the paralleled modules operated with right current satisfying module efficiency request. High operation efficiency of paralleled power system was realized by ensuring high efficiency operating modules. Simulation and experiment results shown that the paralleled power system could operate with higher efficiency adopting the current sharing strategy based on efficiency.

Keywords: parallel, DC-DC converter, efficiency, current sharing, module.

1 Introduction

With abundant electronic equipment applied in various industry fields, high power, high power density and safe power system is demanded. The paralleled power system has numerous advantages contrasted with traditional single centralization power system, such as high current, high reliability, redundancy characteristic, modularization and low cost, etc[1-6]. So, paralleled power system is an importance development direction of Power Technology[7][8].

Commonly, the output terminal of converter module can't be directly paralleled. For avoiding heavy load or over loading in paralleled modules, current sharing technique is applied in paralleled system.

A number of current sharing approaches have been proposed in the [9]-[14], including passive and active methods using analog or digital controllers. Previous current sharing approaches have respective characteristics, but the basic principle is accordant, which is insuring paralleled modules sharing in load current averagely with changeless paralleled modules number. The aim of previous approaches is to maintain the same current stress on paralleled modules, the operation efficiency of module and paralleled power system haven't been considered.

For reasonable energy availability, a current sharing strategy of paralleled converter based on efficiency is presented in this paper. The paralleled modules number adjusting and the current distribution for paralleled modules ought to be done

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according to the operation efficiency of converter. The performances of operating converters are utilized adequately and high efficiency of paralleled power system is maintained.

2 Control Principle

Many factors will have effect on the operation efficiency of DC-DC converter, such as circuit parameters and circuit operation condition etc. When converter topology, circuit parameters and control mode are certain, the operation efficiency of converter can be regarded as the function of output power. According to the research on converter efficiency, it is concluded that when circuit parameters, frequency, input voltage and output voltage are fixed, the efficiency of Buck converter rises firstly and then decreases with the output current. Fig.1 shows the typical efficiency curves of Buck converter with different output voltage.

According to Fig.1, the operation current of converter has an allowable adjusting ranges (I_{min}-I_{max}) in which converter can satisfy efficiency need. If the current of every operating module is between the allowable ranges in paralleled system, the operation efficiency of every module can satisfy work need and high efficiency of paralleled power system can be realized.

For realizing high efficiency of paralleled power system, the paralleled module number can be adjusted and the current distribution for paralleled modules can be done according to load change. The operation current of every paralleled module is between the current ranges satisfying efficiency need. When power system operates with heavy load, the paralleled module number ought to be added to realize the operation current of every paralleled module less than I_{max}. When power system operates with light load, the paralleled module number ought to be decreased to realize the operation current of every paralleled module higher than I_{min}.

Setting the paralleled modules number N, the most operation current satisfying efficiency need can be defined as the reference current of front N-1 modules, namely I_{ref}=I_{max}, which can satisfy least paralleled modules need. For satisfying the output power need of paralleled power system, the reference current of the Nth module is defined according to (1).

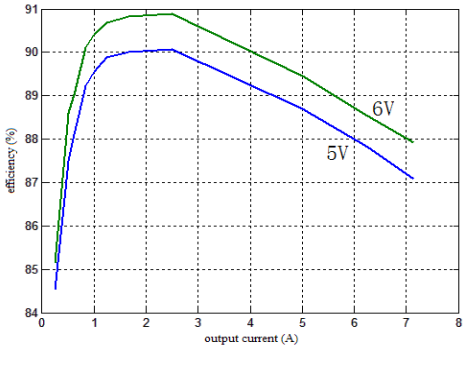


Fig. 1. The typical efficiency curves of Buck converter with different output voltage

$$I_{Nref} = I_{load} - \sum_{i=1}^{N-1} I_{iref} \tag{1}$$

I_{load} is the output current of paralleled power system.

If the reference current of the Nth module defined according to (1) is less than the least current satisfying efficiency need, namely $I_{Nref}<I_{min}$, the least current is defined as the reference current of the Nth module, namely $I_{Nref}=I_{min}$, and the reference current of the N-1th module is defined according to (2).

$$I_{(N-1)ref} = I_{load} - I_{Nref} - \sum_{i=1}^{N-2} I_{iref} \tag{2}$$

The operation current of the N-1th module isn't the most operation current satisfying efficiency need and is decreased.

3 Control Realization

Fig.2 is the control block diagram of paralleled system and the equivalent current source represents the paralleled converter module. Module controller adjusts the current of module severally. The output voltage of paralleled system is adjusted at load port and the output of voltage controller participates in the current control of every paralleled module.

The master controller of system and the slave controller of every paralleled module jointly realize the control of paralleled system. The main function of master controller is the current distribution strategy and the output voltage adjusting of system at load port. The current distribution strategy involves the paralleled module number adjusting according to load change and the reference output current of every operating module defining. The slave controller of operating module realizes the current adjusting of module according to the reference output current defined by master controller, the output of voltage controller and the sampling current of module.

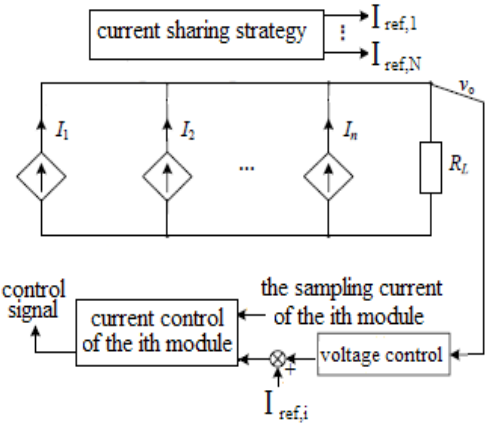


Fig. 2. The typical efficiency curves of Buck converter with different output voltage

The main work of this paper is the research and validating for the current sharing strategy of paralleled converter based on efficiency, so, PI control is adopted in current adjusting and voltage adjusting, whose optimization will be the subsequent research work.

4 Simulation and Experiment Results

The simulation tests are done in Matlab/simulink. The whole module number of paralleled Buck converter system is three. The input voltage of system V_{in}=24V, the output voltage V_o=10V. The parameters of module are as follows: inductor L=100μH, inductor equivalent resistance R_L=0.123Ω, on-resistance of power switch R_{on}=0.042Ω, turn-on time of power switch t_{on}=66ns, turn-off time of power switch t_{off}=189ns, switch frequency f=100 kHz, on-voltage of diode V_{on}=0.7V.

Fig.3 is the simulation results of paralleled system with load change. For showing the inductor current continuity or discontinuity, the curves shown in Fig.3 are inductor current waves of modules. In simulation, the output capacitance of module is ideal, so the output current of module is equal to the inductor current.

The paralleled module number is invariable in Fig.3 (a). In Fig.3 (b), when load changes from 15A to 0.5A at 2.5ms, the paralleled module number is decreased.

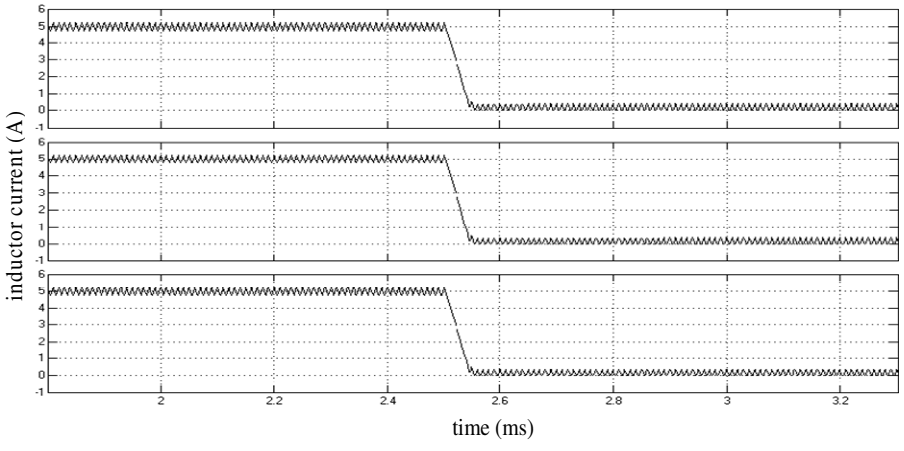
In Fig.3 (a), the current of every module changes from 5A to 0.167A when load changes, the operation mode of module changes form continuous inductor current mode (CCM) to discontinuous inductor current mode (DCM), the efficiency of system changes from 84.33% to 80.54%. In Fig.3 (b), when system operates with light load, the paralleled module number decreases to one, the operation mode of paralleled module is always CCM and high efficiency is ensured. In Fig.3 (b), the current of paralleled module is 0.5A and other modules are taken off, the efficiency of system is 83.22% which is higher than the efficiency in DCM.

Fig.4 is corresponding experiment results. Four curves show respectively the output voltage of system, the output current of three modules.

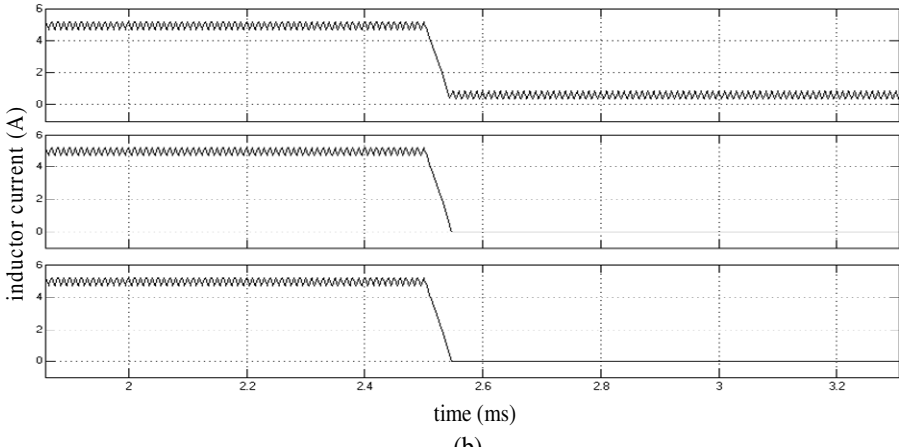
The output current is sampled by adopting Hall sensor, the output voltage is detected by resistance detection circuit, DSPIC30F4012-30I/SP is adopted to complete A/D conversion and realize PI control, the output signal of DSP is separated from the driving circuit of switching by adopting optocoupler.

In Fig.4 (a), the paralleled module number is invariable, when load changes, the efficiency of system changes from 81.12% to 67.49%. In Fig.4 (b), the paralleled module number decreases to one, the efficiency of system changes from 81.12% to 76.14%.

According to the simulation and experiment results, high operation efficiency of paralleled power system is realized by decreasing the paralleled module number when the system operates with light load.



(a)



(b)

Fig. 3. The simulation results of paralleled system

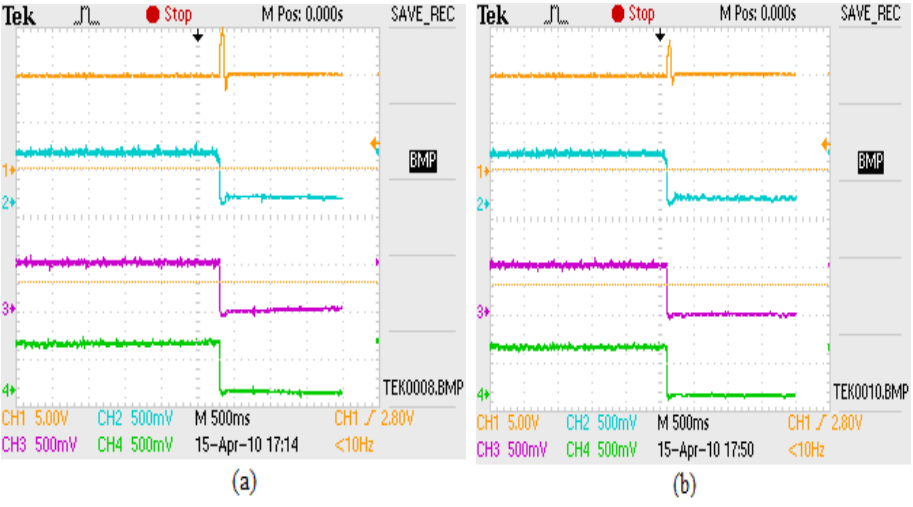


Fig. 4. The experiment results of paralleled system

5 Conclusion

For improving the operation efficiency of paralleled DC-DC converters power system, the paralleled module number adjusting strategy based on efficiency is presented. The paralleled modules number adjusting and the current distribution for paralleled modules are done according to the efficiency need of paralleled power system. Simulation and experiment results shown that the paralleled power system could operate with higher efficiency adopting the current sharing strategy based on efficiency.

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The Harmonics Control Method of Inverter in Induction Heating Power Supply

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Abstract. In this paper, the induction heating power supply adopting cascaded multilevel inverter was the study object. For improving the quality of output voltage in induction heating power supply inverter, a harmonics control mean of output voltage by selecting switching angles were presented. The harmonics equation system of output voltage in two modules cascaded multilevel inverter were established based on the Fourier expression of the output voltage. Based on the work characteristic of induction hearting power supply, the calculation method of eliminating harmonics and the reasonable advice about switching angles were given. Simulation and experiment results shown the total harmonic distortion (THD) of output voltage can be reduced by adopting the harmonics control mean presented in this paper.

Keywords: induction heating power supply, inverter, harmonics control, switching angles, the total harmonic distortion.

1 Introduction

Induction heating power supply can convert electric energy to heat energy utilizing electromagnetic induction. It is widely used in metallurgy, metal heating treatment field and has a powerful pushing force for national economy[1,2]. With environmental consciousness enhancing, induction heating power supply will have enormous extended advantage in industry field because of pollution-free, no noise and good work environment.

In single frequency output application field of induction heating, the frequency of fundamental voltage is equal to the resonance frequency of load, and only fundamental voltage can transfer energy to load. For improving the utilization ratio of inverter power supply and avoiding false resonance problem, the total harmonic distortion (THD) of output voltage ought to be decreased and the quality of voltage wave ought to be improved. In more frequency output application field of induction heating[3-7], corresponding method ought to be adopted to adjust the harmonics of output voltage in inverter[8]. Above-mentioned application needs for induction heating give the actual request for harmonics control in power supply.

For improving the output power of induction heating power supply and decreasing the voltage stress on power switching, Reference [3] and [8] have introduced the idea of multilevel inverter for induction heating, [9] analyzed the work mode of cascaded

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multilevel inverter in induction heating power supply. In this paper, the induction heating power supply adopting cascaded multilevel inverter is regard as study object. A harmonics control mean of inverter is presented to decrease THD of output voltage, improve the waveform quality of output voltage of inverter in induction heating power supply and enhancing the utilization ratio of inverter power supply.

2 The Harmonics Control of Inverter

2.1 Induction Heating Power Supply Based on Cascaded Multilevel Inverter

Fig.1 is the circuit structure of induction heating power supply based on cascaded multilevel inverter[10], the cascaded inverter module number is two. M_1~M_8 is power MOSFET, VD_1~VD_8 is body diode, L_r is load equivalent inductor, R_r is load equivalent resistance, C_r is compensation capacitance, E is DC power supply.

The driving signal of power MOSFET and the output voltage waveform of inverter are shown in Fig.2. The switching angles of different power MOSFET are described by θ_1, θ_2 and the expression including θ and π.

Equation (1) is the output voltage Fourier expression of inverter.

$$F(\omega t) = \sum_{oddn} \frac{4E}{n\pi} [\sin(n\theta_1)\cos(n\omega t) + (\cos(n\theta_1) + \cos(n\theta_2))\sin(n\omega t)] \tag{1}$$

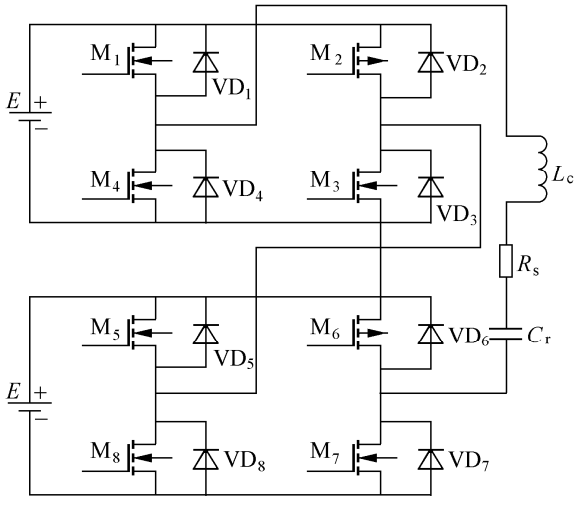

Fig. 1. The structure of the Induction Heating Power Supply Based on Multilevel Inverter

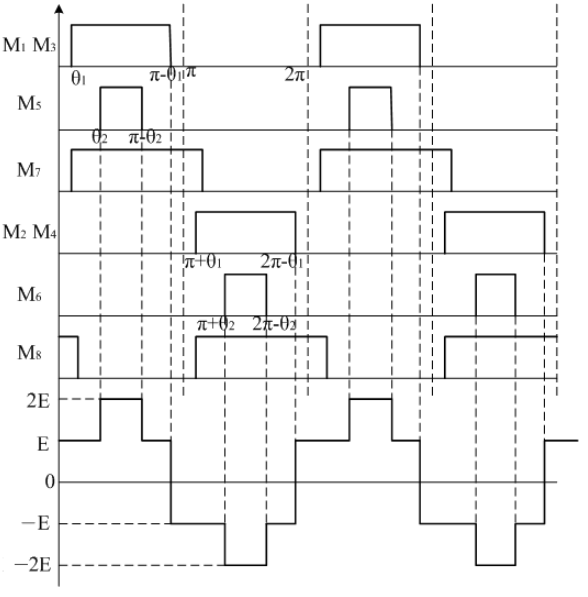

Fig. 2. The driving signal of switch and output voltage waveform of inverter

2.2 The Harmonics Control of Inverter

For deducing the amplitude expression of various-order harmonics, (1) can be converted into (2).

$$F(\omega t) = \sum_{oddn} \frac{4}{n\pi} \sqrt{a_n^2 + b_n^2} \cos(n\omega t - \beta_n) \tag{2}$$
$$= V_1 \cos(\omega t - \beta_1) + V_3 \cos(3\omega t - \beta_3) + \cdots\cdots + V_n \cos(n\omega t - \beta_n)$$

here, $\beta_n = arctg \frac{b_n}{a_n}$, $a_n = E\sin(n\theta_1)$, $b_n = E\cos(n\theta_1) + E\cos(n\theta_2)$, $V_1, V_3 \ldots\ldots V_n$ represents respectively the amplitude of fundamental voltage and various-order harmonics.

$$V_3 = \frac{4E}{3\pi} \sqrt{(\sin(3\theta_1))^2 + (\cos(3\theta_1) + \cos(3\theta_2))^2}$$
$$\vdots \qquad \vdots \qquad \vdots \qquad .$$
$$V_n = \frac{4E}{n\pi} \sqrt{(\sin(n\theta_1))^2 + (\cos(n\theta_1) + \cos(n\theta_2))^2}$$

Equation (3) shows the amplitude expressions of fundamental voltage and the third-order harmonics.

$$\begin{cases} \frac{4E}{\pi} \sqrt{\sin^2(\theta_1) + (\cos(\theta_1) + \cos(\theta_2))^2} = V_1 \\ \frac{4E}{3\pi} \sqrt{\sin^2(3\theta_1) + (\cos(3\theta_1) + \cos(3\theta_2))^2} = V_3 \end{cases} \tag{3}$$

Equation (3) can be converted into (4) by adopting double angle formula.

$$\begin{cases} 1+x_2^2+2x_1x_2=y \\ 1+16x_2^6-24x_2^4+9x_2^2+32x_1^3x_2^3-24x_1x_2^3-24x_1^3x_2+18x_1x_2=f(x_1,x_2) \end{cases} \tag{4}$$

here, $y=(\dfrac{V_1\pi}{4E})^2$, $x_1=\cos\theta$, $x_2=\cos\theta_2$.

Satisfying the need of dead region in driving signals, the harmonics control equation system for taking the limit value of the third-order harmonics is shown in (5).

$$\begin{cases} 1+x_2^2+2x_1x_2=y \\ \dfrac{\partial f}{\partial x_2}=16x_2^5-16x_2^3+3x_2+16x_1^3x_2^2-12x_1x_2^2-4x_1^3+3x_1=0 \end{cases} \tag{5}$$

According to the reasonable values condition of module switching angles in multilevel inverter, the restriction condition of unknown quantity (switching angles cosine) in (5) is $0<x_2\le x_1<1$.

Adopting elimination method and Setting y-1=z, (5) can be converted into (6).

$$\begin{aligned} &(4x_2^2-1)z^3+(3x_2^2-12x_2^4)z^2+(12x_2^6-15x_2^4+3x_2^2)z \\ &+(28x_2^8-19x_2^6+3x_2^4)=0 \end{aligned} \tag{6}$$

Cardan formula is used to solve (6) and the solution is as follows:

$$\begin{cases} x_1=\dfrac{y-1-x_2^2}{2x_2} \\ y=1+w-\dfrac{p}{3w}-\dfrac{a}{3} \end{cases} \quad \text{or} \quad \begin{cases} x_1=1 \\ x_2=\dfrac{1}{2} \end{cases} .$$

Fig.3 describes the relation of y and x_1,x_2. Fig.4 describes the relation of y and switching angles(θ_1, θ_2). Fig.5 describes the ration of the third-order harmonics and fundamental voltage with different y, namely THD_3(THD_3 expresses the total harmonic distortion during three-order harmonics). Fig.6 shows the total harmonic distortion of inverter output voltage which is represented by THD_{1999}.

For improving the waveform quality of output voltage of inverter in induction heating power supply, θ_1 and θ_2 ought to be selected according to the need of THD_3 in power supply. Moreover, in the actual application of induction heating, θ_1 ought to be selected considering the work frequency of inverter and the turn-off characteristic of power switching, so, power switching can reliably turn off during current exchange. θ_2 ought to be selected considering the load power factor angle in actual application for providing reasonable dead region of driving signals and avoiding power supply short circuit.

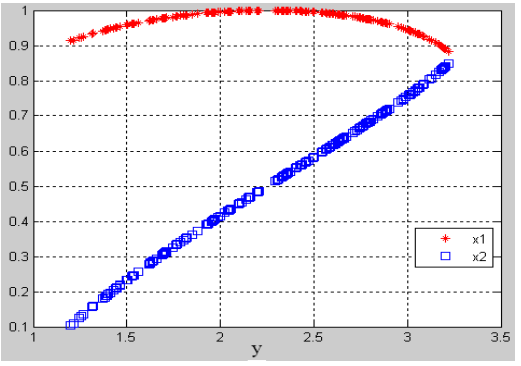

Fig. 3. x_1 , x_2 versus y

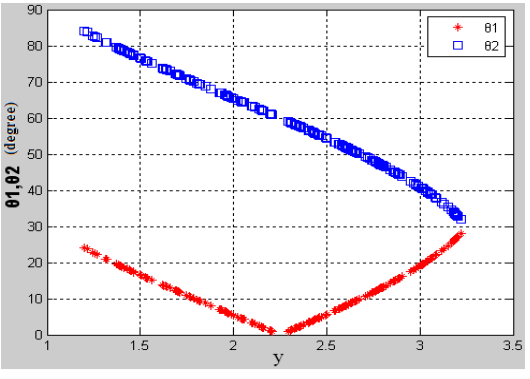

Fig. 4. θ_1 , θ_2 versus y

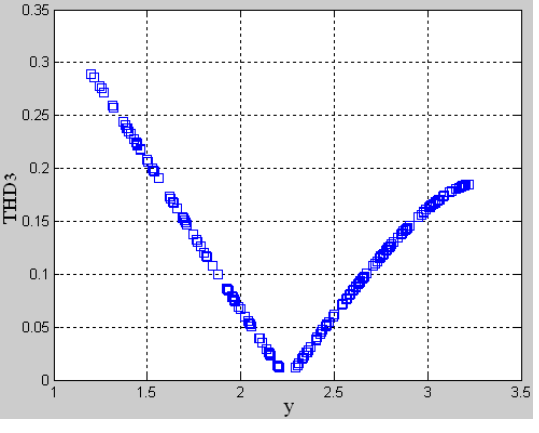

Fig. 5. THD_3 versus y

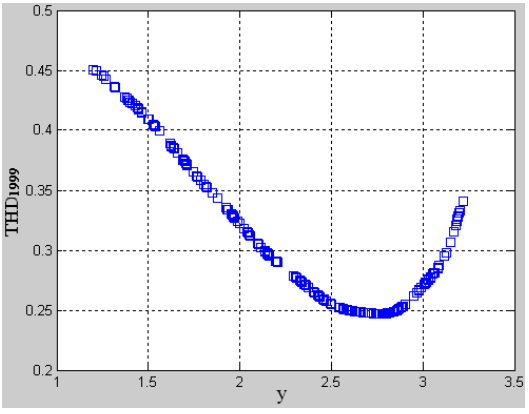

Fig. 6. THD_{1999} versus y

3 Simulation and Experiment Results

In simulation test, y=2.6633, switching angles θ_1=9.6^0, θ_2=50.4^0, E=50V, the fundamental frequency f=500kHz. Fig.7 is the simulation results of inverter output voltage and Fourier waveform. THD_3 equals approximatively 0.091 by calculating based on the data in Fig.7.

Fig.8 is corresponding experiment results. THD_3 equals approximatively 0.089 by calculating based on the data of oscillographin.

Simulation and experiment results show that the harmonics control of inverter output voltage in induction heating power supply can be realized by selecting θ_1 and θ_2 based on the harmonics control method presented in this paper.

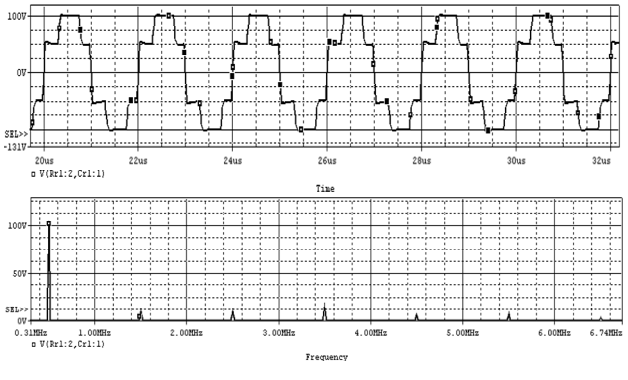

Fig. 7. Simulation waveform of inverter output voltage

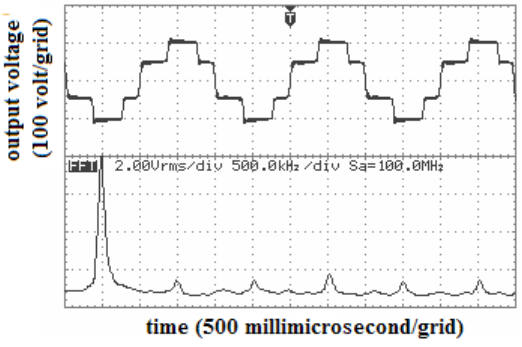

Fig. 8. Experiment waveform of inverter Output voltage

4 Conclusion

For improving the utilization ratio of inverter power supply, a harmonics control mean of output voltage in induction heating power supply is presented. Based on the characteristic of output voltage of multilevel inverter in induction hearting power supply, basic procedure of eliminating specified harmonics in two modules cascaded multilevel inverter is deduced. By taking the limit value of the third-order harmonics, the third-order harmonics component in output voltage is decreased and the reasonable values of switching angles are advised.

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Design and Implementation of a Kind of Calibrator for Secondary Instrument

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Abstract. The secondary instrument calibrator is mainly used for testing and calibrating the temperature or flux measuring meters used in engineering projects. In this paper, we mainly describe the design and implementation process of it. The Mcs51 microprocessor of the Intel Corporation, $5\frac{1}{2}$ bits A/D converter with micro-processor, and LCD module are used in our design. Furthermore, standard current source circuit and control circuit must be considered. On one hand, the calibrator can be used as a voltmeter or ammeter. On the other hand, it can provide high precision current source for the calibration of secondary instruments.

Keywords: Secondary instrument, calibrator, A/D converter, Single-chip.

1 Introduction

Primary instrument and secondary instrument are idioms in instrument installation project. The exact names of them should be measuring instrument and display instrument. Measuring instrument is direct contact with the measured object, and is often set in the outdoor scene. The display instrument is mostly set in the control room and its data come from the measuring instrument. In engineering projects, frequent verification and calibration work is needed for the secondary instruments in order to guarantee their normal work and measuring accuracy. The secondary instrument calibrator is a kind of instrument for dealing with the verification and calibration work. In this paper, the principle and developing procedure of a kind of high precision, high resolution, and hand-held field testing instrument are introduced in detail. It can directly make the comprehensive test and calibration to the temperature and flux secondary instrument.

2 Circuit Principle

The calibrator not only has the function of measuring voltage and current, but also can output analogy DC signal which is required for calibrating other secondary instruments when it is connected with measuring instrument in parallel or series ways. Figure 1 is the calibrator's working principle diagram.

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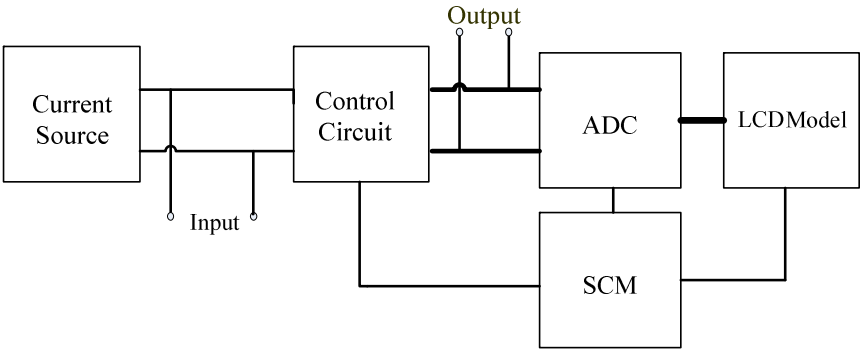

Fig. 1. The calibrator's principle diagram

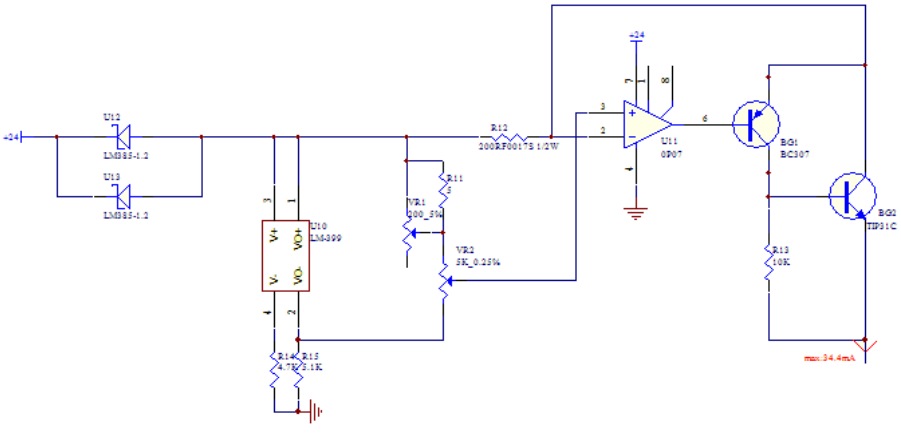

Fig. 2. The current source circuit

The whole circuit can work in two modes: "source" mode and "input" measurement mode, and one of the two modes could be chosen as working mode through a mechanical button. When "input" mode is chosen, the calibrator can measure input current or voltage accurately and the measuring result can be shown by LCD module. This equals to a precise voltmeter or ammeter. To show the measuring result with LCD, the analogy result should be converted to digital value through an A/D converter (ADC) and the conversion process needs to be controlled with a single chip microcomputer (SCM).

When "source" mode is chosen, the calibrator can provide some types of high precision voltage source or current source. The concrete source type can be chosen through mechanical buttons. The voltage or current source provided on one hand displays on the LCD under the control of the SCM, on the other hand, they can be outputted to other secondary instruments and complete the accuracy test of them.

3 Source Circuit

As a secondary instrument calibrator, its function is to provide a high accurate current source with higher resolution than the second instrument to be calibrated. The source circuit's principle diagram in this paper is shown in figure 2. The high precision reference voltage source chip LM399 used in source circuit has low temperature coefficient and has a constant temperature circuit internally. This can ensure its long-term stability. LM385-1.2 is bipolar micro-power voltage reference diode. OP07 is a dual polarity op-amp integrated circuit with low noise and ultra low offset voltage, which is used to amplify source current signal produced in front. Next the signal is outputted via BC307 and TIP31C transistors.

By adjusting the variable resistors VR1 and VR2, the precise current outputted can reach the maximum at 34.4 mA. And it can also be converted to voltage output through a resistance network.

4 A/D Conversion Circuit

A/D converter is the core part of the calibrator. It is used to convert an analog signal to a digital quantity, which can be processed by SCM and then sent to LCD to display.

We choose the A/D converter HI-7159 produced by Intersil Company in circuit. The Intersil HI-7159A is a monolithic A/D converter that uses a unique dual slope technique which allows it to resolve input changes as small as 1 part in 200,000 (10μV) without the use of critical external components. Its digital auto zeroing feature virtually eliminates zero drift over temperature. The device is fabricated in Intersil' proprietary low noise BiMOS process, resulting in exceptional linearity and noise performance. The HI-7159A's resolution can be switched between a high resolution

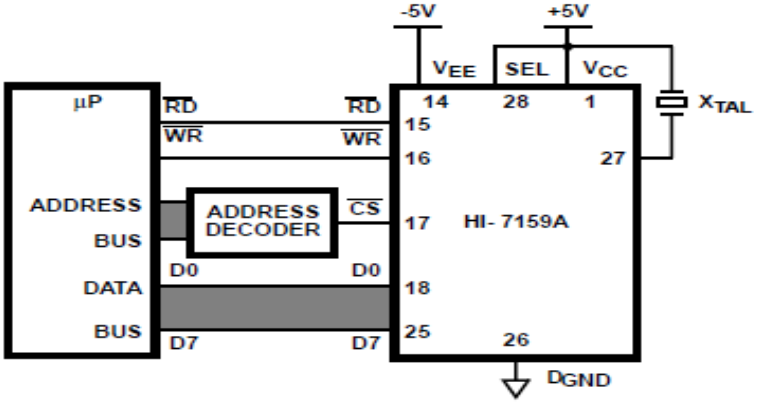

Fig. 3. Interface of HI7159 to SCM

200,000 count (51/2 digit) mode, and a high speed 20,000 count (41/2 digit) mode without any hardware modifications. In the 41/2 digit uncompensated mode, speeds of 60 conversions per second can be achieved. The HI-7159A is designed to be easily interfaced with most microprocessors through either of its three serial and one parallel interface modes. In the serial modes, any one of four common baud rates is available.

The interface between HI-7159 and the SCM is shown in figure 3. This paper will don't explain specific principle. Readers can look up related material.

5 Summary

This paper briefly introduces a secondary instrument calibrator, including the design idea and the core part of the circuit. The calibrator mainly completes comprehensive testing and calibration operation of temperature secondary instruments and flux secondary instruments used in industrial sites. The actual product has the characteristics of high accuracy, high resolution, lightweight, portable, etc.

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Apply Jute Fiber to Enrichment the Microorganism for Purification the PAHs in Water

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Abstract. The research on effects of purifying the PAHs in water is to apply a plant material which is jute fiber to enrichment the microorganism for purification the PAHs. The results of this research turns out that the jute fiber material has better effect of purifying the PAHs in water, and the purification effects are highly related with jute fiber's layout density, HRT and aeration rate. The higher the layout density of jute fiver, HRT and aeration rate, the better the effects of purification**,** which means the water quality of effluent meets the GB5749-2006 standard that the total content of PAHs is less than 2000 ng·L-1 . With the same density of jute fiver or HRT or aeration rate, the purifying rate is significantly around 3% less with large ring PAHs than with small ring PAHs in water. The number one water tank with jute fiber, 12h HRT and 6 h aeration has the best purifying effect. Therefore, the jute fiber can better purify the PHAs in water.

Keywords: Plant fiber, Organic Pollutants, PAHs, Microorganism.

1 Introduction

Polycyclic aromatic hydrocarbons (PAHs) refer to a class of compounds which are two or more benzene rings linked together.It is the largest class of cancer-causing chemicals in the environment[1]. Because of fossil fuel combustion, waste incineration, refined oil, coke and asphalt production, PAHs are widely distributed in the environment. In 1979, U.S. EPA identified 16 PAHs in the list as monitoring priority pollutants[2] Studies have shown that generally, the detection rate of a small ring PAHs in water is higher than the detection rate of large ring. Among those PHAs, naphthalene has the highest detection rate, and phenanthrene, pyrene, fluoranthene, fluorene, and other compounds has lower detection rates[3]. Water body in China has generally been polluted by PAHs, and the content is much higher than the content in foreign countries[4-7]. PAHs in the water generally change with the seasons; during dry season the content of PAHs in water is usually significantly higher than that in wet period[8]. Ming Xi's[9] study on the PAHs in Yangtze River estuary found low-ring PAHs were

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detected in each section in different concentration levels with the range from 53.3 to 417.6ng/L. The concentration in summer wet season was higher than the concentration in autumn and winter's dry season periods. Wang Ping et al's[10] research on PAHs contamination in Lanzhou section of Yellow River sample showed that all 16 PAHs were detected with the total PAHs concentrations ranged from 2920 to 6680ng/L. in which chrysene and pyrene had higher content, and the proportion of smaller PAHs molecular weight larger. Ju Lizhong[11] found that the total concentration of 10 different kinds of PAHs in Hangzhou's surface water is between 989ng/L and 96210ng/L.

Inoculating of efficient exogenous microorganisms, adding microbial nutrients, providing the electron acceptor, providing co-metabolite and improving the bioavailability are several measures[12] we use to promote the bioremediation at the present time. The studies of PAHs by domestic researchers mainly focused on the investigation[13,14] of distribution of PAHs in the environment and on distribution and hazards of PAHs in the environment, microbial degradation of PAHs, and bioremediation field study of the increasing bioavailability and the construction of engineered bacteria[15,16]. Some researchers studied using artificial dielectric material to enrich microbial to improve the lake water quality, which relates to persistent organic pollutants[17] removal, has made certain effects. As most of the microorganisms in nature are difficult to grow in laboratory conditions, it is difficult to cultivate to depredate PHAs[16]. So far, the use of natural jute fiber dielectric material indigenous microorganisms' enrichment of PAHs in water purification research is rarely reported. This study took a city drinking water source as subject; by using bio-film formed and attached on fiber surface to enrich the indigenous microorganisms in water resources so that we can degrade PAHs in water.

2 Materials and Methods

2.1 Experiment Equipment

Test process is shown in Figure 1. The test water is pumped into the high level tank through lift pump by the way of gravity flow, low-inlet and high-outlet and flow-control entering the elevated tank. Drain the treated water out of test tanks after biological purification. The size of the tanks is 100cm × 80cm × 50cm (length × width × high =) and the actual experimental water capacity is 350L. Make the jute fiber into the fiber ropes with 2mm diameter. Then, fixed the jute fiber ropes at 800mm bars with 2mm spacing between each rope. After that, these bars were suspended in the test tanks with approximately 2.0cm (No1), 2.5cm (No2), 3.3mm (No3) and 5.0mm (No4) spacing separately in each test tank. The indigenous microorganisms would naturally grow and be enriched on the jute fiber surface. The control group (No5) would not place jute fibers.

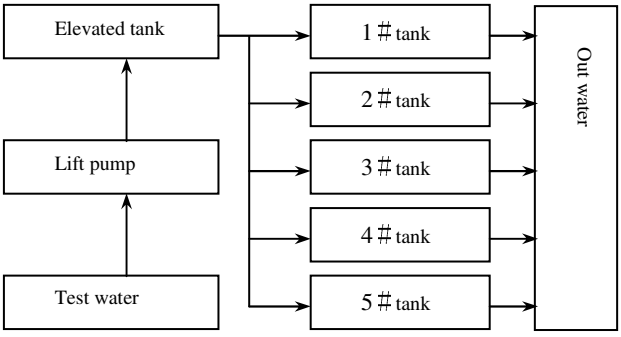

Fig. 1. Flow chart of experiment

2.2 Experiment Methods

The experiment was carry out on HPLC instrument of LC1100 series produced by Agilent Technologies Co., Ltd, a UV variable wavelength detector with ODS-C18, 150mm × 0.46mm reversed-phase chromatograph column.

The measurement conditions were 25℃column temperature, water-acetonitrile gradient elution, 1.2mL/min mobile phase injection and 20μL Loop manual injection.

Reagents acetonitrile, dichloromethane and isopropanol were HPLC grade and other reagents were analytical grade (distilled in 0.45μmmembrane filter before use). Experiment using water was ultra-pure water distilled from demonized water by Quartz sub-boiling distiller.

The Solid-phase extraction of PAHs in sample water adopted second elution technique. First time eluent was 1:1 isopropyl alcohol and tetrahydrofuran, which can prevent loss of volatile PAHs and thesecond time eluent was dichloromethane, which can increase the recovery of 5 or 6 ring PAHs. The recovery rate analysis and the lower limit of detection were shown in Table 1.

Table 1. Recovery and detection limit

PAHs	detection limit /ng·L^{-1}	Recovery /%
Nap	0.66	111.6
Ace	0.67	89.0
Acy	0.65	111
Flu	0.69	96.3
Phe	0.80	100.2
Ant	0.63	85.9
Flua	0.55	104.3
Pyr	0.49	115.9
Chr	0.48	102.6
BbF	1.59	99.8
BkF	1.62	82.7
DahA	3.12	95.5

3 Results Analysis

3.1 Jute Fiber Density Effect on Purification of PAHs

Test water was taken from a city surface (river) drinking water. Benzo [a] anthracene, benzo [a] pyrene, benzo [g, h, I] pyrene andindeno [1,2,3 -cd] pyrene were not detected from the testwater. The highest concentrate was fluorene1887ng / L, followed by pyrene and naphthalene, and the remained PHAs were at low levels. Water quality situation was shown in Table 1. After 35-day natural bio-film developing to the end, maintained HRT= 12h. After stable operating, the results of biological purification of the test water by different jute fiber density were shown in Table 2. Meanwhile draw Figure 2 according to the results above. Experimental time period was from 2008-05-18 to 2008-07-04.

According to Table 2 and Figure 2, compared with the control group, of PAHs in different jute fiber density groups have better purification effects than the control group, the greater the density the better purification effects. The total purification rates in tankNo.1, tank No.2, tank No.3 and tank No.4 were 78.82%, 68.29%, 57.19% and 47.97% respectively; the purification effects of same density jute fiber were significant different between different PAHs, the decomposition rate of large rings (5 and 6 rings) PAHs was significantly lower than the decomposition rate of a small ring (2 to 4 rings). The treated water met the total PAHs content less than 2000 ng·L-1GB5749-2006 standard.

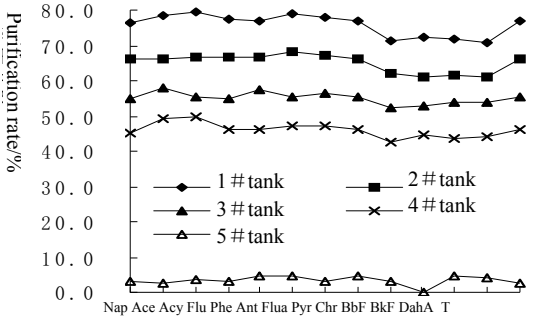

Fig. 2. Purification rate of different medium density /%

Table 2. Effect of different medium density on PAHs Purification / ng·L^{-1}

PAHs	Test water	1#	2#	3#	4#	5#
Nap	531	119	166	233	281	522
Ace	119	21	39	48	55	116
Acy	116	20	30	51	56	112
Flu	1887	386	598	818	987	1849
Phe	159	30	51	67	77	152
Ant	39	9	11	16	20	36
Flua	61	14	14	26	30	55
Pyr	529	119	178	209	279	524
Chr	25	10	12	13	15	21
BbF	33	7	9	15	20	34
BkF	42	14	15	18	20	38
DahA	38	9	12	18	22	35
Total	3579	758	1135	1532	1862	3494

3.2 HRT Effect on PAHs Purification

Based on section3.1, tank No.1 has the best purification effects, so that we use the density in this tank in the following experiment. Select HRT values as 4h, 8h, 12h, 16h and 20h respectively to explore the effects of different HRT. The experimental results were shown in Table 3. Draw Figure 3 based on table 3. The experimental time period was from 2008-07-18 to 2008-09-04. According to table3 and Figure 3, HRT has obvious impact on the purifying process, and the higher HRT value the better purification effect.

As of HRT increased, the decomposition rate of PAHs increased. The total decomposition rate of PAHs for 4h, 8h, 12h, 16h and 20h were 69.82%, 72.79%, 77.83%, 78.46% and 79.34% respectively. The decomposition rate increased considerably when HRT values were 4h, 8h and 12h, and the growth rate were 2.97% and 5.04% respectively while the HRT were 12h, 16h and 20h, the decomposition rate had smaller increase with the growth rate 0.63% and 0.74% respectively. Under the same HRT, the decomposition rate of large rings was about 2 percent lower than that of small rings.

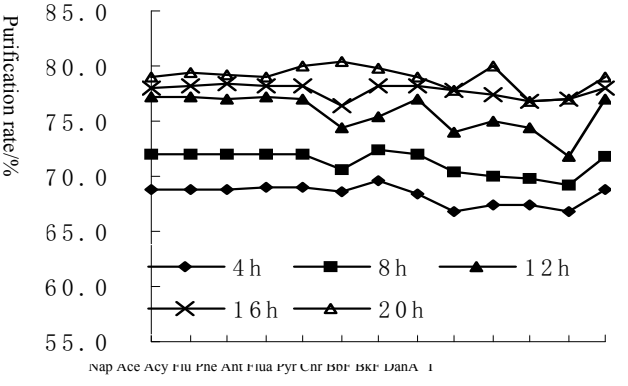

Fig. 3. Purification rate of different HRT **/%**

Table 3. Effect of different HRT on PAHs Purification / ng·L^{-1}

PAHs	Test water	4h	8h	12h	16h	20h
Nap	618	178	170	130	128	122
Ace	178	55	46	37	36	32
Acy	197	61	50	41	39	35
Flu	1876	566	509	410	403	391
Phe	218	66	59	52	48	45
Ant	49	14	13	13	11	10
Flua	66	18	17	17	15	14
Pyr	603	188	169	143	138	133
Chr	25	8	8	6	6	7
BbF	37	12	10	8	8	8
BkF	41	13	12	9	9	9
DahA	35	11	10	8	8	9
Total	3943	1190	1073	874	849	815

3.3 Aeration's Effect on PAHs Purification

From section 3.2, we can choose HRT value as 12h to discuss aeration effects on decomposition rate of PAHs. The aeration modes contained continuous aeration, intermittent aeration and no aeration. By using intermittent aeration, set aeration time to 2h (continuously aerate for1h every 6h), 4h (continuously aerate 2h every 6h) and 6h (continuously aerate 3h every 6h). Aeration devices were those aeration tanks with sand core aeration heads connected with air mass flow meter through hose and then connected with aerator pump. The aeration volume was controlled in the 5m3 / h or so. The experimental results were shown in Table 4. The experiment time period was from 2008-09-15 to 2008-10-31.

Table 4 shows that the aeration significantly affected the purifying effects of PAHs. With the increase in the amount of aeration, the rate of PAHs increased. The total purification rate of continuous aeration was 86.98% clean. When aeration time were 2h, 4h, and 6h, the total rate of intermittent aeration were 80.47%, 83.50%and 85.86% respectively.The purification rate of non-aeration was 77.22%. When aeration time was 2h, 4h and 6h, purification rate were significantly different. Furthermore, we can observe that for aeration time equals to 6h, there is no much difference from continue aeration method on purification rate. Among all the aeration methods, non aeration has the lowest rate. With the same aeration purification, the decomposition rate of large ring was significantly lower than that of small rings.

Table 4. Effect of different **a**eration intensity on PAHs degradation/ ng·L^{-1}

PAHs	Test water	Not	2h	4h	6h	Sequence
Nap	575	118	102	89	73	69
Ace	157	31	26	21	17	15
Acy	141	30	24	20	16	15
Flu	1889	430	360	310	266	245
Phe	213	48	45	34	30	26
Ant	51	11	9	8	7	7
Flua	64	15	13	12	11	10
Pyr	598	141	126	101	88	81
Chr	42	10	9	8	7	7
BbF	49	11	10	9	9	8
BkF	46	12	11	9	8	7
DahA	41	11	9	8	7	6
Total	3866	868	744	629	539	496

3.4 PAHs Purification Analysis

With the increase density of jute fiber, jute fiber can provide the largest possible growth space for the indigenous microorganisms in water body to attached, and provide good growing conditions so that the indigenous microorganisms can rapidly form the bio-film that is attached to the growth on the jute fiber surface. Also the jute fiber can provide a good biochemical reaction microenvironment for indigenous microorganisms to enhance the natural decomposition of PAHs. There are a lot of different types of indigenous microorganisms existing in water body, many bacteria, fungi and algae have the ability to decompose PAHs. After water contaminated by PAHs, there were natural selection process, that a number of specific indigenous microorganism produce

enzymes which can decompose PAHs in the induction of PAHs contaminants then decompose and converted PAHs.

Indigenous microorganisms have the potential PAHs decomposition ability. They have strong PAHs catabolism ability, diversified species and high metabolic rate. One way the microorganisms such as Aeromonas, Alcaligenes and Bacillus and other microorganisms decomposing the PAHs is taking PAHs as only carbon and energy source to decompose them. Another way is the microorganisms such as White-rot Fungi, Bjerkandera adusta and Cunninghamella elegans co-metabolism (or co-oxidation) with other organics to decompose the PAHs. Microorganisms can directly decompose small molecules PAHs, with the requirement of oxygen to produce dioxygenase during the purification process. Under the action of dioxygenase decompose the benzene ring[18]. It is usually by way of co-metabolism to decompose macromolecular metabolism PAHs, for this method can improve the purification efficiency and improve the substrate structure of microbial carbon source and energy, increasing range for microorganism to choose source of carbon and energy. Therefore we can achieve the purposes that decompose and utilize those difficult to decompose PAHs by microorganisms.

4 Conclusions

Jute fiber density, HRT and aeration all have significant effect on decomposition of PAHs. With the jute fiber density, HRT and aeration increase, the purification rate also increases. The treated water quality met the GB5749-2006 standard which is total PAHs content less than 2000 ng·L-1.

When using the same jute fiber density or HRT or aeration, the decomposition rate of large ring PAHs was about 2% significantly lower than the rate of small ring. Select natural material density in tank NO.1, 12h HRT and 6h aeration can lead to the best decomposition effects of PAHs.

There are a lot of different types of indigenous microorganisms existing in water body, many bacteria, fungi and algae have the ability to decompose PAHs. After water contaminated by PAHs, there were natural selection process, that a number of specific indigenous microorganism produce enzymes which can decompose PAHs in the induction of PAHs contaminants then decompose and converted PAHs. Jute fiber can provide a good biochemical reaction microenvironment for indigenous microorganisms to enhance the natural decomposition of PAHs.

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Laboratory Model Test on Foundation Reinforcement by Locating Pile at Both Side of Strip Footing

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Abstract. Using similarity theory as guidance, the paper designs the laboratory model test on foundation reinforcement by locating fly ash-lime pile and wheat-lime pile at both side of strip footing, and researches the destruction, foundation bearing capacity, p-s curve, in view of economic conditions at the rural area. The results show that the fly ash-lime pile and the wheat-lime pile can effectively improve the foundation bearing capacity, and reduce the amount of ground settlement; the yield point elongation, which appears in load-settlement curve of the wheat-lime pile, can be further improved foundation safety degree.

Keywords: fly ash-lime pile, model test, foundation reinforcement, wheat-lime pile.

1 Introduction

At present, the construction had changed the large-scale construction period gradually into the building and strengthening periods in china, which need foundation reinforcement, many experts and scholars on the foundation reinforcement technology had done a lot of research, achieved some results, and presented various reinforcement methods, but these reinforcement methods cost too much and equipment complex, they are difficult to apply to the low house foundation reinforcement [1-2] of the villages and towns. In view of this situation, this text uses the lime and fly ash and wheat straw as reinforcement materials, conposing pile to reinforce strip foundation in both sides. The reinforcement technique does not damage the original foundation, and has the advantages of convenient construction, low cost, easy materials, which are suitable for the vast rural area foundation reinforcement.

Through the model test, this article research after the reinforcement, the foundation bearing capacity, deformation and failure morphology, settlement changes with the load distribution, which should be valuable for design and construction for double ash piles and wheat-lime piled ,at the same time promoting it in the rural areas and promoting the application.

2 The Model Test Design [3]

A Test device

Model box adopts a common steel plate, the size is 190cm long, 110cm wide, and 150cm high, thick of steel plate is 3mm. The facade part of test box adopts 10mm thick organic glass plate.

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B The soil material

The test model soil is silty clay, the design bulk density is 18KN/m3, the moisture content is 16%, and dry density is 15.52KN/m3. Model box filling soil is stratified into tamp by weight method, the measured model soil basic properties such as shown in table 1.

Table 1. Basic Physics Indicators of Foundation Soil

rock and soil name	dry density （g/cm3）	moisture content （%）	wet density (g/ cm3)	liquid limit w_L （%）	plastic limit w_p （%）	cohesive force （kPa）	Friction angle （°）
silty clay	1.55	16	1.8	26.5	13.3	20	29.4

C Pile material

The wheat-lime pile materials include wheat straw, lime and soil, the ratio is 0.25%: 8%: 1. In order to prevent corrosion of wheat straw, this test adopts varnish for anti-corrosive.

The fly ash-lime pile materials include lime and fly ash. The test adopts class I fly ash. The lime and fly ash's mixture ratio of model test is 3: 7 (dry ash mass ratio).

D Test scheme

Test one: unreinforced soil model.

Text two: foundation reinforced by wheat-lime pile on both sides of the loading;

Text three: foundation reinforcement by double ash piles on both sides of the loading.

The arrangement of wheat-lime pile and double ash piles are shown in Figure 1 and figure 2.

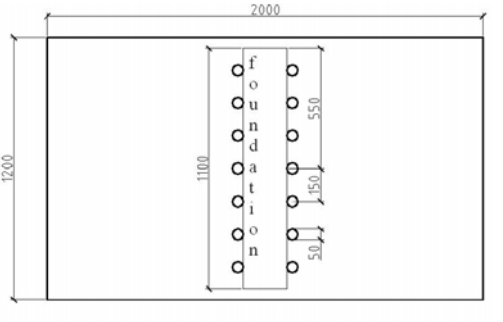

Fig. 1. Plan layout of model piles

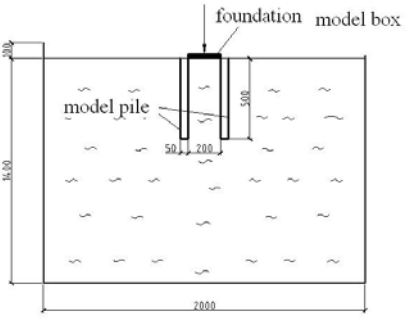

Fig. 2. Profile layout of model piles

Model pile design mainly consider the ratio of base width B, pile diameter D=B/4 =5cm, pile length l=2.5B=50cm, along the length direction of strip foundation arranged the pile on both sides, the pile center distance 3D (15cm).

E Measuring points

In order to measure the foundation surface settlement value, the dial gauges are arranged on base plate, which are shown in figure 3. There are four dial indicators, which arranged on the base plate at each of the opposite ends of a base plate, layout a dial indicator on the middle base plate's two sides.

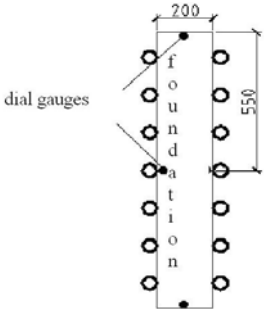

Fig. 3. Layout diagram of settlement observation points

3 Analysis of Test Results

A Experimental phenomena

1) Foundation of no reinforcement

After test loading completion, foundation soil surface crack situation are as shown in Figure 4. In parallel with the base to give priority, on both sides of foundation soil have slight bulge and edge soil crush. Observation of a predetermined set of white line changes, it can continuously observe the soil beneath foundation with the increase of load deformation, what is shown in figure 5.

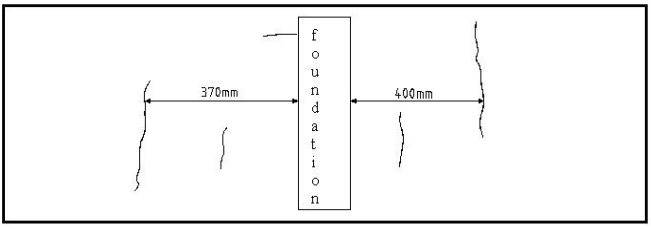

Fig. 4. Schematic plot of the foundation soil fissure of test 1

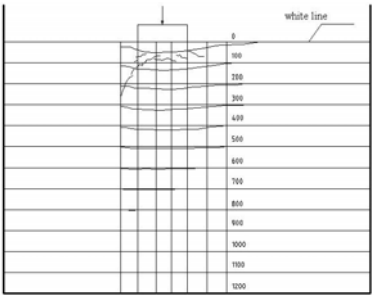

Fig. 5. The deformation observation curve of foundation soil test 1

Soil vertical deformation depth is mainly in foundation below 3B range, i.e. the upper load transfer pressures mainly bear by this range of soil. Soil settlement deformation is biggest close to the base axis, just below the soil foundation settlement decrease along with the depth increase, and gradually and evenly.

2) The wheat-lime pile

In this test process, the surface soil of foundation is not shown that crack parallel to the base, just a few minor cracks perpendicular to the base, as shown in figure 6. In the later period of test, the sinkage of white line almost entirely focus in the below of the base plate model, the two sides of the white line did not significantly change, as shown in figure 7. And the depth of soil's vertical deformation is below the base of 2B range, soil settlement deformation where in the same depth under the foundation is uniform and decreases along with the depth increases

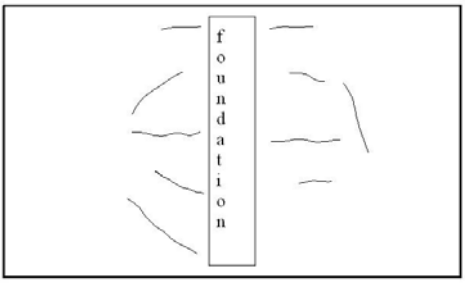

Fig. 6. Schematic plot of the foundation soil fissure of test 2 and test 3

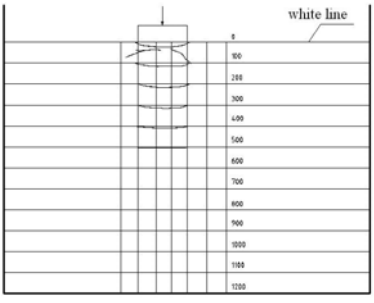

Fig. 7. The deformation observation curve of foundation soil test 2

After the test, dug the soil beneath foundation, and the wheat-lime pile exposed (shown in figure 8, 9),

Fig. 8. Pile cement with the soil around pile

Fig. 9. The shear deformation of wheat-lime pile

3) Double ash piles

Through the crack development of this test, and the change of white line, it is shown that the situation of white movement of this test and wheat-lime pile test are the same basically.

After the test, the soil below excavation of foundation plate and the double ash piles exposed, as shown in figure 10, 11.

Fig. 10. Fly ash-lime pile cement with the soil around pile

Fig. 11. The fracture position of fly ash-lime pile

Through the observation of wheat-lime piles and double ash piles , it is shown that double ash piles is solider than wheat-lime pile; the two piles' shear and compressive strength are obviously higher than that of foundation soil, and the soil around pile was solider than that of the ordinary soil, forming a layer of hard and compact cementation layer, not easy to dig, and cemented with the pile body together to form a body structure that is larger in diameter than the pile body (Figure 8, 10); Within the 1B range, most of the wheat-lime pile dilate, and in the depth of the 1.25B (about 250mm) have shear deformation (as shown in Figure 9).At shear deformation part, two symmetrical pile spacing changes from 240mm to 290mm, illustrating that there is an obvious yield deformation process before wheat-lime pile rupture, it is advantageous for the foundation safety. Due to compaction and cementation, double ash piles soil degree of compaction and shear strength increase greatly, it is very difficult to dig out, account for the soil between piles and double ash piles together will make them like two curtain foundation to restrict soil in partial space. Most double ash piles split in 10cm (as shown in Figure 11); therefore shear failure of double ash piles in foundation reinforcement may occur in the superficial layer of 10cm.

B Comparison analysis of load-settlement curve

This test adopts grading loading, each stage loading is 10kPa. Through the three tests, test results as shown in Figure 12.

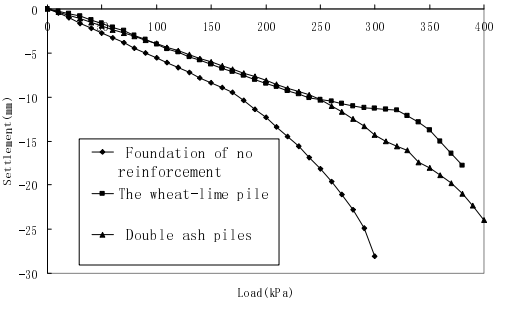

Fig. 12. Load-settlement curve of the three tests

According to P-S curve, the soil proportion limit, ultimate load, the characteristic value of bearing capacity and settlement of each model tests are shown in table 2.

Table 2. Proportion Limits and Ultimate Loads of the Three Tests

Model test	Proportion limit （kPa）	Ultimate load （kPa）	Characteristic value of bearing capacity （kPa）	Final settlement （mm）
Foundation	170	290	145	28.04
Foundation reinforced by wheat-lime pile	240	380	190	17.81
Foundation reinforced by double ash piles	270	400	200	23.96

Figure 12 shows, with the same loads, test two and test three of the settlement was significantly smaller than the test one; From table 2, it can see that set a double ash piles and wheat-lime pile on both sides of pile can reinforce foundation, improving the capacity of foundation soil, the characteristic value of bearing capacity of double ash piles and wheat straw pile are 1.4 and 1.3 times larger than no reinforcement foundation.

Tt is worth notice that choose any section of the actual strip foundation and can define it as rigid foundation soil, in the experiment, because of the model box bulging deformation is larger, the texts are finish, and the actual ultimate bearing capacity can not be measured, and through testing pressure data, the other sides and bottom pressure of model box is small, so the two reinforcement methods for characteristic value of bearing capacity enhancement degree should be larger than the above. By the graph 13 it can still be seen that the settlement of foundation reinforced by wheat-lime pile, under certain load, grew slowly, tends to be parallel to the P axis horizontal lines, this feature of curves is similar as reinforcement yield, so it can further improve the foundation safety degree. At the same time, compared the wheat-lime pile and double ash piles, after the characteristic values, in the same load, the wheat-lime pole pile deformation is relatively small, and wheat-lime pile cost relatively lowly, more suitable for application in rural areas of China.

4 Conclusions and Suggestions

1) Wheat-lime pile and double ash pile can effectively improve the foundation bearing capacity, reducing the settlement.

2) After foundation are reinforced by wheat-lime piles and two ash pile , it changed the soil distribution situations of cracks, the cracks change from parallel to the basics to perpendicular to the basics.

3) The P-S curve of foundation reinforced by wheat-lime pile have the presence of a yield platform, if can further improve the safety and reliability of the foundation.

The construction technique of foundation reinforcement by locating pile at both side of strip footing is simple, the materials are facile, the cost is low, and also can use industrial waste, it reduces environmental pollution, which is suitable for rural areas where the economic and technical conditions are relatively backward, and is much high promotion and application value for strengthening rural areas' housing foundation.

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Physiological Characteristics of Drought Resistance in Karelinia Caspica and Atriplex Tatarica Combining Pressure-Volume Technique*

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Abstract. *Karelinia caspica(Pall.)Less. Var. Asteraceae* and *Atriplex tatarica L. Var. Chenopodiaceae* are dicotyledonous halophytes. They both have a broad distribution in Xinjiang region of China. This paper is about the drought resistance characteristics and differences of *K. caspica* and *A.tatarica* combining pressure-volume technique (PV technique), aims to further understanding the growth and distribution characteristics of halophytes. The results showed that the predawn water potential and relative water content were higher in *Atriplex tatarica* than that of *K.caspica*, so *A.tatarica* had higher water saturation deficit (RWD_0) than *K.caspica*; Both of them were strong Midday depression of transpiration type, while *A. tatarica* was low water potential dehydration tolerance type, *K.caspica* was high water potential dehydration detention type; *A.tatarica* had higher turgor (ψ), elastic modulus ($\varepsilon_{\max}$)and osmotic adjustment ability than *K.caspica*, so it can maintain the stability of water potential and prevent cell dehydration. To some extent, *A. tatarica* had stronger drought resistance than *K.caspica*.

Keywords: *Karelinia caspica*, *Atriplex tatarica*, Pressure-Volume technique, predawn water potential, drought resistance.

1 Introduction

Drought and salinization are the important restriction factors for desert - oasis ecological sustainable development. Under the drought condition, drought-resistance of halophytes is the important factor that leading to vegetation distribution and succession.

Karelinia caspica (Pall.)Less. Var is the Compositae perennial herbaceous plants which has a C3 photosynthetic pathway. *Atriplex tatarica L.*is annuals C4

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chenopodiaceae plant, both of them are dicotyledonous halophytes, and have a broad distribution in Xinjiang region of China. Understanding these drought characteristics of two different halophytes is very important for the utilization and improvement of halophytes and saline soil resource.

Water content, relative water content (RWC), Saturation deficit (SD) and water potential (ψ) were used for the characterization of plant water status, which reflected a real plant water status. The water composition, potential tissue maximum osmotic potential, water stress on feedback regulation ability and endurance of the plant internal organs, only the water parameters through pressure-volume (PV) technique can be described.

Therefore, combined with PV technology, we explored the drought resistance physiological characteristics and differences of *K. caspica* and *A. tatarica*, aimed to enrich knowledge of the halophyte, and provide a scientific guide for the development and utilization of saline soil agricultural sustainable development.

2 Material and Methods

2.1 Sample Condition

The study was carried out in 134th regiment 17 company (44°42′54.3″N, 85°22′42.6″E) of Shihezi city, the Xinjiang Uygur Autonomous Region, Northwest of China. It was located in the northern part of Tianshan, the southern margin of Junggar Basin, and belonged to alluvial plains. With average annual rainfall 136.9mm, annual average temperature 7.3 ℃, ≥ 10 ℃ accumulated temperature 2627 ℃; historical average sunshine hours 2828.2h; and annual average frost-free period 163 days. The experiment site was located in 500 acres abandoned wasteland in 1980s. It was chloride - sulfate slightly alkaline saline soil (land work manual), with soil bulk density 1.46g cm-1, pH 7.83-7.89, electrical conductivity (soil to water ratio of the extract is 1:5) 3.7-4.2dS m-1 and buried ground water depth 2.5-3m. It was mixed saltbush community composed of *K.caspica* and *A.tatarica*.

In this study, *K.caspica* and *A.tatarica* were investigated, native to Xin Jiang of Northwest in China. As a perennial subshrub, *K.caspica* is reviving in early April, blooming in July and August, bearing in September and wilting before frosty. *A.tatarica* is an annual C4 grass which has stronger adaptability in drought and saline habitats of Northwest in China, Central Asia and Siberia, and flowing and bearing between July and September. Both of *K.caspica* and *A.tatarica* are edible for cattle, sheep and camel at areas where local eximious grazing are insufficient.

2.2 Experimental Method

2.2.1 The PV Curve Drawing

In July 27, 2010, the foliage from 60cm above the ground to the top in *K.caspica* and *A.tatarica* were cut (3-4 repeats). Wrapped with aluminum foil and brought to the lab, it was soaked in deionized water for 24 h. After saturated, it was measured using SKYE (SKPM-1400) type plant pressure chamber for the plant water potential, and accumulated outflow was determined by 1/10000 balance. Specific parameters determination and calculation referred the relevant paper[3].

Theoretically, PV curve consists of hyperbolic and linear. Of which the reciprocal of the y-coordinate of intersection, was osmotic potential of critical plasmolysis. The value of x-coordinates is cumulative outflow at the critical plasmolysis. We draw the PV curves used Sigmaplot 10 quoted with Li Hongjian [4] method, Hyperbolic and linear equations were fitted, and obtained the hyperbolic and linear nodical coordinate value via simultaneous equations.

In Fig.1, the intersection of x-coordinate is demarcation point of organization symplastic water and apoplastic water. The intersection of y-coordinate is the reciprocal of osmotic potential ψ_{π}^{100} at the full expansion. The point of tangency of Straight and curve part is the critical water status when turgor was lost in plant tissue, the point corresponding to percentage x-coordinate and y-coordinate are critical infiltration water amount and the reciprocal of the critical water potential. The critical infiltration water amount that tissue water content is critical water saturation deficit (RWD_0).

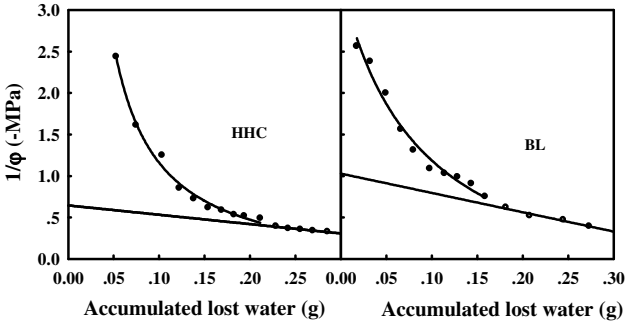

Fig. 1. PV Curves of Karelinia caspica and Atriplex tatarica

2.2.2 PV Curve Parameters Calculation

Hyperbolic equation and linear equation were got by fitting scatter diagram through Sigmaplot10.0. Infiltration water and critical osmotic potential at plasmolysis were obtained through simultaneously solved for hyperbolic equations and linear equations.

The reciprocal of osmotic potential $\psi_{\pi}^{100}(-MPa)$ at full expansion was obtained When x=0 in f=yBB$_{0BB}$+ax of linear regression equation based on PV technique. So, the point of intersection between linear and y-coordinate in *K.caspica* was 0.6456, and water potential was 1.5489, that is ψ_{π}^{100}=1.5489 in *K.caspica* based on $1/\psi_{\pi}^{100} = y_0$; and the point of intersection between linear and y-coordinate in *A.tatarica* was 1.0284, and water potential was 0.9742, that is ψ_{π}^{100}=1.5489 in *A.tatarica*.

2.3 Relative Water Content[5]=(Fresh Mass-dry Mass)/ (Saturated Mass-dry Mass)

Freshly leaves were packed with aluminum foil, brought to laboratory right away, and weighted (fresh mass). The leaves were placed in deionized water for overnight. After determined the saturated mass, the plants were oven-dried for 72 h at 80℃ and weighted (dry mass).

3 Results

3.1 Drought Resistance of *K. caspica* and *A. tatarica*

A.tatarica had larger turgor (ψ_p^{100}) than *K.caspica*(Table 2), which enabled plant to resist water stress, and facilitated cell elongation, plant growth and biochemical process. The osmotic potential at full of inflation (ψ_π^{100}) in *A. tatarica* is -0.97Mpa, while *K. caspica* was -1.55Mpa. Lower value of ψ_π^{100}, indicated that cells concentration was higher, and the ability of growth and related physiological activities can be performed under low water potential. At the same time, the osmotic potential value (ψ') at plasmolysis in *A. tatarica* (-1.66MPa) was also lower than that of osmotic potential value (-2.59Mpa) in *K. caspica*. It indicated that *A. tatarica* has strong endured low osmotic potential ability, which is also one of the reasons of *A. tatarica* more drought tolerance than *K. caspica* in arid habitat.

Table 1. The regression coefficients and correlation analysis by PV curves

Species	Equation	Coefficients			R
		a	b	y_0	
Karelinia caspia	$f_1 = y_0 + (a*b)(b+x)$	-53.01	-0.0025	-0.20	0.9957*
	$f_2 = y_0 + ax$	-1.13		0.65	0.9845*
Atriplex tatarica	$f_1 = y_0 + (a*b)(b+x)$	4.04	0.089	-0.72	0.9879*
	$f_2 = y_0 + ax$	-2.33		1.03	0.9831*

The critical water saturation deficit (RWD_0) of two plants was *A.tatarica* (0.2%) > *K.caspica* (0.15%). The bigger Critical water saturation deficit, the stronger plants drought resistance under water stress. In addition, cell maximum elastic modulus (11.07Mpa) in *A. tatarica* was 11.07MPa, which was about 10 times as much as *K.caspica*. The hard cell wall in *A. tatarica* availed maintaining high water potential and turgor.

The ratio of bound water and free water ratio (Vb / Vf) (1.88) in *A. tatarica* was smaller than that in *K. caspica* (3.59). But woody Saltbush had high bound water content[6] under drought stress condition . On differences of *A.tatarica* and other Atriplex, further research is needed.

The bigger of DI value, the stronger of drought resistance. The drought resistance index (DI) in *A. tatarica* was 2.94, more than that in *K. caspica* (2.39). The above indexes proved that *A. tatarica* has stronger drought resistance than *K.caspica*.

3.2 The Relative Water Content and Water Potential Changes in Plants

The ability of plant adapting to extreme drought stress mainly depends on the dehydration tolerance ability of protoplast. The relative water content in *K.caspica* and

A. tatarica decreased gradually with growth (Fig.2), In October, Relative water content were minimum at October, 68.39% in *K.caspica* and 87.97% in *A.tatarica* lower than that in July. Relative water content is lower in *A.tatarica* than that in *K.caspica*, 57.55%, 65.48%, 66% and 21.90% from July to October respectively. Obviously, Relative water content was higher in *K.caspica* than that in *A. tatarica*. Under the drought condition, in order to enhance the anti-transpiration and anti-high light capacity, relative water content decreased in *A. tatarica*, thereby the water activity and evaporation were reduced with the purpose of maintaining plant physiological function.

Table 2. Parameters of PV curves of two herbs

Parameters	***Karelinia caspica***	***Atriplex tatarica***
$\psi_p^{100}(MPa)$	0.18	0.60
$\psi_\pi^{100}(-MPa)$	1.55	0.97
$V_f(\%)$	0.22	0.35
$V_b(\%)$	0.78	0.65
V_b/V_f	3.59	1.88
$RWD_0(\%)$	0.15	0.20
$\psi'(-MPa)$	2.59	1.66
$\varepsilon_{(\max)}(MPa)$	1.13	11.07
DI	2.39	2.94

Plant predawn water potential can well reflect the status of plant water supply, which can be used to judge the plant water deficit degree. Plant with strong drought resistance can maintain well water status and help to the photosynthesis and other physiological processes at the water stress period. Predawn water potential in *K.caspica* was larger than that in *A. tatarica*, and decreased with seasonal (Fig. 3). Predawn water potential in *K. caspica* was significantly greater than that in *A.tatarica* at productive periods in July ($P< 0.05$) and August ($P< 0.001$). With the growing process, Plant predawn water potential in *K.caspica* and *A.tatarica* decreased, but not significantly difference at intraspecies. If water deficit was calculated by subtracting the predawn water potential from leaf water potential at any time, lower predawn water potential is the base of lower water deficit in *A.tatarica*; this was accordance with the PV curve results that *A.tatarica* had greater critical water saturation deficit ($RWDBB_{0BB}$) than *K. caspica*, which showed that the drought tolerance in *A.tatarica* was larger than that in *K.caspica*. In addition, lower relative water content was closely related with extremely lower predawn water potential in *A. tatarica*.

As a result of long-term adaptation to the growth environment, a set of growth physiological and ecological characteristics were developed. Annuals plant *A. tatarica* and perennials plant *K.caspica* as widely distributed species in Xinjiang arid region, also developed a series of drought resistance mechanism. Both of them belonged to the strong xerophytes light transpiration noon break types, according to Dong Xuejun[8], both of them reduced transpiration and avoided the further water loss through stomata closure at midday. But the drought resistant mechanisms were different, high water potential, high relative water content characteristics of *K. caspica* can be classified as high water potential and delay dehydration, while low water potential and low relative

water content characteristics in *A. tatarica* can be classified as low water potential and dehydration tolerance type. Different drought resistance physiological characteristics were determined by the different morphology and growth pattern.

Drought resistance is positively correlated with osmotic adjustment ability of plants under water stress. Osmotic potential is reduced by two ways: one is cells concentration by dehydration; the other is the intracellular solute increases. The two pathways are coexistence in the plants. The structural integrity of the cell under low water potential was maintained by solute accumulation and increased cell wall rigidity in *Z. mauritiana* [10]. *A. tatarica* and *K.caspica* can also accumulate inorganic ions, especially $Cl^{-1}$and Na^{+}, in order to reduce osmotic potential[9] and the lower $\psi^{'}$ and ψ_{π}^{100} value. *A.nummularia* had similar osmotic characteristics[11]. However, Osmotic adjustment in *A.halimus* was not necessary in the process of plant drought tolerance, and the contribution of soluble sugar was greater than betaine in cell osmotic regulation[12]. Differences of drought resistance characteristic between *A. tatarica* and other Atriplex also need further research.

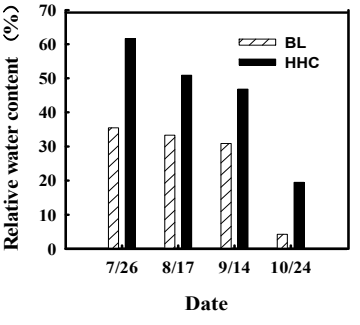

Fig. 2. The relative water content of two Halophytes

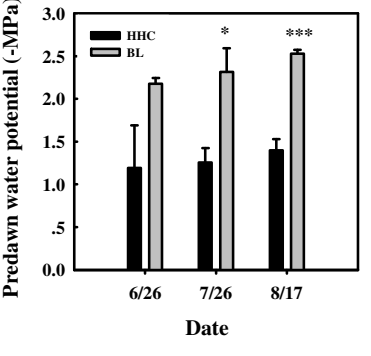

Fig. 3. The predawn plant potential of two halophytes from June to September (Note: * : P<0.05; ***: P<0.001)

4 Conclusion

(1) The predawn water potential and relative water content were higher in *A. tatarica* than that of *K.caspica*, so *A.tatarica* had higher water saturation deficit ($RWDBB_{0BB}$) than *K.caspica*; Both of them were strong Midday depression of transpiration type, while *A. tatarica* was low water potential dehydration tolerance type, *K.caspica* was high water potential dehydration detention type;

(2) *A.tatarica* had higher turgor (ψ), elastic modulus (ε_{max}) and osmotic adjustment ability than *K.caspica*, so it can maintain the stability of water potential and prevent cell dehydration.

To some extent, *A.tatarica* had stronger drought resistance than *K.caspica*.

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Study on Market-Driven Management of Commercial Bank

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Abstract. As service business, due to low technical content of products, easy to imitate and intense market competition, commercial bank more need market-driven management. This paper summarized the content of market-driven management and the establishment of market-driven organization, designed organizational structure of commercial bank under market-driven strategy, defined the responsibility of each department, described the relationship between the various departments.

Keywords: market-driven management, commercial bank, organization, strategic concept, responsibility.

1 Introduction

The changes of customer demand led to the diversification of products and stimulate the market further breakdown. Traditional market boundaries have been disrupted a large number of alternative products caused by technologies and made the change of market structure. Growing unified market trends made the closed domestic market change to the interconnected global market. Every enterprise was in the dramatic changing market, even though the successful companies have no time to stop and celebrate. Before competitors catch up, enterprises must constantly innovate to create new sources of advantage, otherwise will soon be out of the market. At the same time, each market has great uncertainty due to three elements that changes of demographic and lifestyle, technological upgrading and environmentalism. A company must carry on market-driven management to be in sync with the market management process.

2 Related Literatures Review

2.1 Market-Driven Marketing

Market-driven marketing takes customers as the core of marketing process, develops and produces the products to meet their needs through carefully research the target market. It perceives customers are the object of all business activities. The needs of customers are the yardsticks of business activities. Enterprises should arrange

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production according to the wishes and preferences of customers. Enterprises produce the products meeting to the needs of customers can not only increase the interests of customers, but also can make their own profit. The Initiative to produce what products is not in companies, nor in the governments, but in the thought of customers [1].

The excellent results of enterprises are obtained from establishing a solid competitive advantage in the competition of market. The competitive advantage has come from sustained create value for customers better than the competitors [2].

2.2 Market-Driven Organization

Establish a market-driven organization is the key of implement market-driven management to obtain valid competitiveness. Its core is to follow the deep and enduring faith of customer first and the aim is to attract and meet the needs of customers.

Based on the procedures, beliefs and values infiltrated all aspects of activities, guided by deep understanding to the needs and behavior of customers, the abilities and purposes of competitors, market-driven organization can achieve superior results through achieving customer satisfaction more than the competitors.

Market-driven organization focuses on the value chain of external customers, tries to find and achieve value from the activity cycle of customers. Meanwhile, enterprises join the value chain of customers with the internal value chain and the value chain of partners to form a complete enterprise space value chain.

The nature characteristics of market-driven organization is able to effectively identify, attract and retain valuable customers, form unique competitive advantage and ultimately get value in return [3].

2.3 The Contents of Market-Driven Management

Market-driven management includes two aspects. First, it should take a shared strategic concept as a guide in the management process. Second, it must be response to market requirements and continuously effort to satisfy customers.

1) Strategic concept: Strategic concept illustrates the nature of enterprise and future intentions. If the lack of strategic concept and the leadership to unite people under this concept, enterprises will only respond to the current field of competition and not to pursue a new direction. Strategic concept of enterprise should have the following four characteristics.

a) Insight: Strategic concept must be based on the understanding to enterprise and the foreseeability what change of the power of manipulation the future will happen. Here the concept is a insight.

b) Share: When the concept is generated through cooperation, the team leader becomes the speaker and responsible of the concept through cooperation, the concept will inspire the entire enterprise. The concept must reflect on the views of leader to opportunity, values and significant transactions. It comes from the groups in the enterprise that will work together to achieve the concept.

c) Competitiveness: Powerful concept is express of the organization to win the confidence. By focusing attention on the attractive leader to understand the

achievements and continuously explore new ways to gain competitive advantage, the activities and ambitions of enterprise are given a clear meaning.

d) Authorization: In the organization that managers have sufficient permissions to make major decisions on strategy, the concept will be very prosperous. These people are authorized to use a common framework under the concept to decide which opportunities or threats should to respond, which can be ignored.

2) Market-oriented concept: The enterprise with market-oriented concept is fertile ground for the concept. Market-oriented concept pursues long-term customer satisfaction. Customer satisfaction can bring generous returns for the enterprise. This is a market theory verified over a long period.

2.4 Steps to Establish a Market-Driven Organization

Market-driven organization approaches to consistent management along four interrelated dimensions. The advantage is the formation of excellent skills with understanding and meeting customer needs. These four dimensions are shared beliefs and values, organizational structure and systems, strategy-making process and support programs, mainly shown in Figure 1 [4].

Steps to establish a market-driven organization are following.

1) Formation of shared beliefs and values: All decision-making of organization take the customer and expected advantage opportunity as starting point. Entire organization persists throughout to provide superior quality and service from the customer perspective. These basic values have continued to support and strengthen by senior managers. Managers break the routine to clarify their concerns to customer. Organization attaches importance to services of value chain at every level, including internal operations, to achieve harmony between employees, and looks members of the entire channel as customers and partners. The organization has strong competitiveness, through close observation of competitors every move, taking the methods not noted by competitors to seek the views of customers, corrects their actions according to the best company.

2) Establishment of organizational structure and systems to reflect market: Organizational structure mainly support to market-driven values and behaviors to strengthen the behavior of the entire enterprise needed. This means that the person closest to customers have full rights and authority of the successful completion of work. Organizational structure must reflect the market segment conditions, determine the role for each major market, and support systems must be consistent with each other. Revenue, cost and shared information reflects results of competition in the market. Market-driven organizational structure make all of functions activities and decision-making focused on market opportunities and problems. Every decision is directly related with others and share with others that the information on customer needs, competitiveness and common information on existing market conditions. The organization encourages open dialogue and quickly decisions-making.

3) Sound strategy-making process: Market-driven enterprises will not form the system without the flexibility. It has a sound process to systematically provide and select the best strategies according to business problems. Adaptation method commonly used to form strategies, integrated top-down and bottom-up mode.

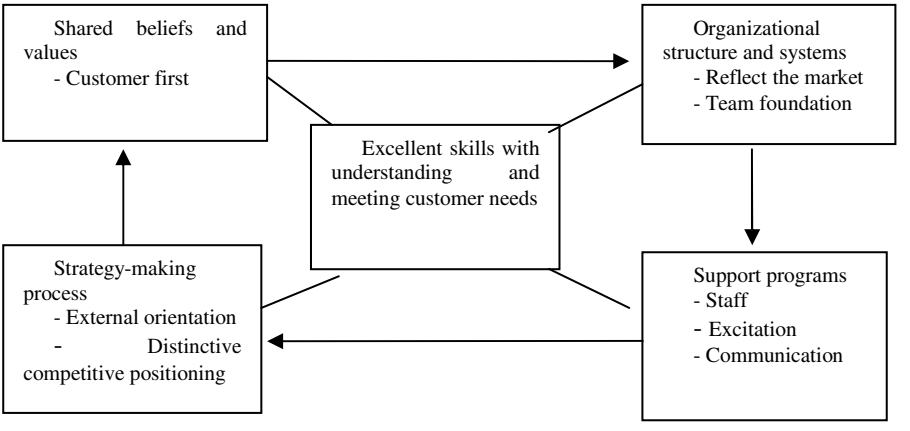

Fig. 1. Content of market-driving management

Adaptation method has four features. First, top-down guidance gives an exciting strategic vision. The strategic vision is challenging for managers of business units. Top-down guidance will ensure that sufficient financial resources to achieve the proposed strategic commitment. Second, the bottom-up information provided is the opportunities and threats faced by enterprises based on detailed analysis of customer needs, channel behavior, technology status and the competitive environment. Third, the method will form a unifying theme, so that all the analysis and dialogue between management will be possible. Fourth, the method forms a flexible, adjustable strategy-making process to promote mutual learning within the organization. The strategy-making process includes four main steps that market information collection and dissemination, information combining between high-level and low-level, selection of strategic direction, resource allocation.

4) Consistent support programs and actions: Through formulating strategic concept, all of the functions and activities combine together based on customer first, which greatly promoted the implementation of the strategy.

3 Market-Driven Management Process of Commercial Bank

3.1 Establishment of Market-Driven Organization

Based on the basic idea of Market-driven strategy, the operating philosophy of commercial banks is to meet the customers' financial needs and urgent need to establish a market-driven organization as Figure 2.

3.2 Responsibilities of Departments

All sectors of the commercial banks can be divided into two levels. The first level are customer relationship and service sectors that mainly to provide services, including five external departments that business department, corporate & institutional clients

department, individual clients department, credit management department, product R&D department, and internal departments that international business department, enterprise credit department, individual credit department. The second level are marketing coordination and control department, mainly to system administrate the bank's internal resources, provide smooth resources allocation background, coordinate service sectors to implement marketing strategy, including risk control department, planning & finance department, internal audit department, human resources department and information department. The main responsibilities of the various departments are as follows.

1) Business department: Business department is responsible for all customers opening and closing accounts, deposits, withdrawals, loan interest calculation and collection, opening approved bank acceptance bills, discounts after approval, provides banking basic products and services, is responsible for specific accounting and business process.

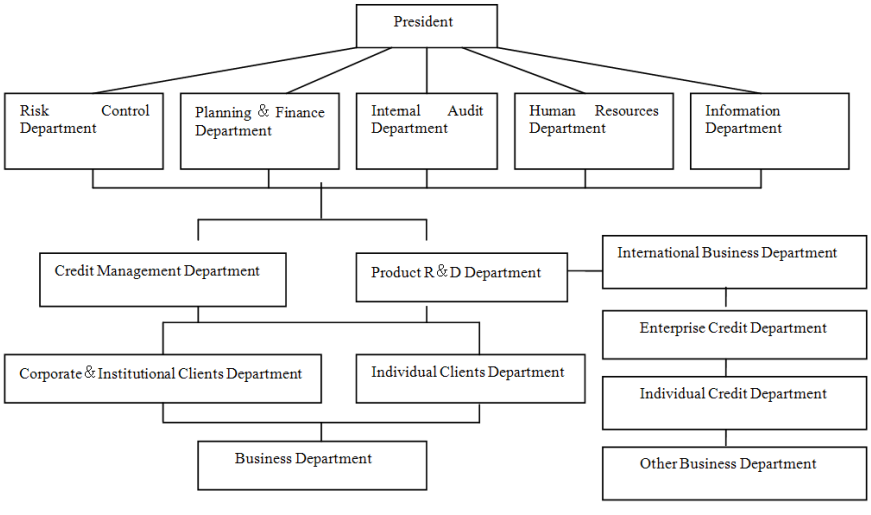

Fig. 2. The organization system of commercial bank

2) Corporate&institutional clients department and individual clients department: They face the customer, is responsible for providing full range of financial services according to different customers' financial needs.

3) Credit management department: Credit management department is responsible for approving credit business, including loans, letters of credit, letters of guarantee, bank acceptance bills and discounts, provides management decision support for clients departments.

4) Product R&D department: Product R & D department is responsible for collecting customer information, re-designing banking products and services process according to customer demand, provides technical support of products and services for clients departments.

5) Risk control department: Risk control department is responsible for policy formulation, risk prevention, inspection for business of credit management department.

6) Planning & finance department: Planning & finance department is mainly responsible for analysis on the cost and profit situation of banking products and services, evaluation to the effect of expenses incurred, management and support for business department from the cost point.

7) Internal audit department: Internal audit department is mainly responsible for conducting business compliance checks to guard against system risk.

8) Human resources department: Human resources department is responsible for staff recruitment, hiring, training, use, promotion, adjustment and performance evaluation.

9) Information department: Information department is is responsible for manage the computer systems, provide good hardware support for clients departments.

10) International business department, enterprise credit department, individual credit department: They are responsible for international business, enterprise credit business and individual credit business, provide customers with major banks products and services.

3.3 Relationship between the Various Departments

Business departments direct contact with customers to meet their needs. Management departments' job is to support the business departments to enable them to better serve customers. President's main task is to support middle managers to better service the front-line employees. All departments must be customer-oriented, all employees should service better to customer. To a corporate lending business process for example, it can be seen from collaborative relationships between departments, as shown in Figure 3.

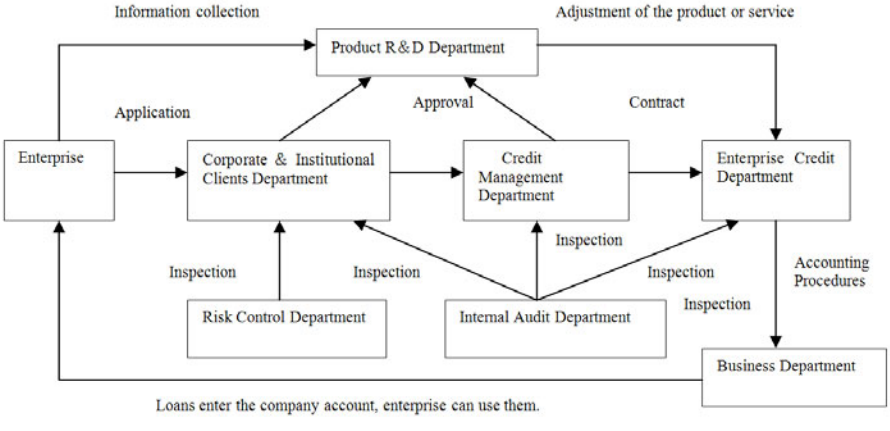

Fig. 3. Process of making a loan for an enterprise

4 Conclusion

In the fierce competition to survive, commercial banks must adapt to the market environment, meet customer needs, carry on market-driven management, under the guidance of shared strategic concept, improve customer satisfaction to achieve their goals, and maintain their own advantage. Only in this way, commercial banks can be competitive and vitality.

Acknowledgment. This research was supported by PhD Foundation and Key Subject Construction Project of North China Institute of Aerospace Engineering.

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Prediction of China's Total Social Logistics Costs Based on Grey Model

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Abstract. China's logistics costs have a higher proportion than the developed countries for a long time. The development of logistics industry has an important contribution to the GDP growth. In a new international environment, the development trends of China's total social logistics costs become the focus of the public. Using the grey system theory to establish the prediction model, this paper predicted the growth of China's total social logistics costs in 2009 and 2010, and verified the credibility of the prediction model from the angle of qualitative analysis.

Keywords: Total Social Logistics Costs, Grey Model, GDP.

1 Introduction

The development of logistics industry has been brought into focus all round the world. The proportion of logistics costs accounting for GDP is been used in measuring the level of logistics development in a country usually. March 25th, 2009, logistics industry has been declared as the revitalization industry by China State Council. At that time, top ten revitalization industries are all out together. Logistics industry involves a wide field, promotes the development of the employment, and plays a vital role in accelerating production and consumption. Accelerating and revitalizing the logistics play an important role in dealing with financial crisis, promoting industrial structure adjustment, transferring economic development mode and enhancing national economic competitiveness.

China's social logistics costs continue staying high for a long time. The proportion of China's social logistics costs in GDP will be up to 10 percent compared with the developed countries. China's GDP was 30 trillion RMB in 2008, social logistics costs was 5.5 trillion RMB, so the proportion of logistics costs accounting for GDP was 5.5/30 = 18%. However the ratio of America logistics costs in GDP was only 10%. From the perspective, China's proportion of logistics costs in GDP is 2 times higher than America's. How about the growth of social logistics costs in the next two years and how about the developing trends in the new environment?

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At present, domestic scholars analyzed the logistics costs from the aspects of industrial structure, macroeconomic index, proposed some countermeasures of reducing logistics costs by analyzing the influence of logistics costs ratio in GDP of developed countries. Social logistics costs are a grey system, and there are many factors that influence social logistics costs. According to the national bureau's statistics reports, social logistics total cost contains three main parts, namely transportation cost, storage cost and overhead cost. This paper tried to use the correlation analysis method of grey system theory of and GM (1,1) prediction model to analyze the relational degree of China's social logistics costs, transportation cost, storage cost and overhead cost, and predicted the developing trend and correlation analysis. It reflected the dynamic development trends of China's social logistics costs, and plays a great part in revitalizing logistics industry and making decision.

2 GM(1,1) Prediction and Grey Correction Analysis Model

2.1 Introduction of Grey System Theory

The gray system contains both known information and unknown information. It is proposed by Professor Julong Deng in 60s of twentieth century. It is widely used in predicting the complex and nonlinear data and has higher prediction accuracy.

GM（1，1）Prediction Model

Original series:

$$X^{(0)}=\{x^{(0)}(1),x^{(0)}(2),\cdots x^{(0)}(n)\}$$

The accumulated generation series:

$$X^{(1)}=\{x^{(1)}(1),x^{(1)}(2),\cdots x^{(1)}(n)\}$$

Differential equation model based on the accumulated generation series,

$$\frac{dX^{(1)}}{dt}+aX^{(1)}=u$$

Discretion description of the solution:

$$X^{(1)}(t+1)=(X^{(0)}(1)-\frac{u}{a})e^{-at}+\frac{u}{a}$$

After determination of the parameters 'a' and 'u', we can get the cumulative series. Then get the prediction value by reversing the model.

2.2 Grey Correlation Analysis

Grey Correlation Analysis method is an important part of gray system. It is a quantitative method of analyzing the link of all factors' correlation in the grey system. The basic idea of judging the grey correlation degree is the sequence curves' geometry similarity degree. The closer of the Curve, the greater of the correlation degree. The Grey correlation coefficient is expressed follows, $\frac{1}{n}\sum_{k=1}^{n}\gamma_{0i}(k)$.

3 Analysis of Relational Degree and Development Trends of China's Social Logistics Costs

3.1 Relational Degree Analysis of China's Total Social LogisticsCosts

The related data of China's social logistics costs of 1991-2008 were collected from the Guoyan website. According to the grey model theory, the transportation cost, overhead cost and storage cost is the child factors, total logistics costs is the mother factor.

Enter the original data into the DPS data processing software, and carry on the relational degree analysis, take the minimum value of each years' absolute difference $\Delta_{min}=0$, distinguish coefficient is 0.1. Drew the relational degree of each child factors toward mother factors:

Table 2. Relational Degree of Social Logistics Costs and Each Component

	Transportation Cost	Storage Cost	Overhead Cost
Relational Degree γ_{0i}	0.525	0.468	0.342

From the table, the order of relational degree: γ transportation cost > γ storage cost> γ overhead cost. The transportation cost has the greatest influence on total social logistics costs, its relational degree is 0.525.It explains that transportation cost accounts for the biggest proportion of total social logistics costs. It is known that the transportation cost includes costs from railway, highway, air, water, pipe and the like, so we should pay more attention to it. The storage cost accounts for more than 30% of the total social logistics costs, including interest, warehousing, insurance, goods loss, and distribution and so on, its relational degree is 0.468. We should improve the efficiency of the each link of logistics industry since the high proportions of logistics costs. Overhead cost includes some fees from logistics management, logistics information system and its operation expenses. It can not be ignored as the relational degree of 0.342.

According to the analysis, there are several causes associated with the logistics costs. First of all, Logistics enterprises of our country generally turns on the phenomenon of scale small but large quantity, disorder of market competition and higher transaction. Second, China logistics technology, especially the logistic information technology results in the low efficiency of logistics management.Thirdly,TPL(Third-Part Logistics) enterprises have a small proportion, and the self-conduction of logistics activities can not realize the specialization and scale economy. All these factors contribute to the rising of logistics costs.

3.2 Trends Analysis of China's Total Social Logistics Costs

To reflect the dynamic changes of China's social logistics costs, we create the grey GM(1,1) prediction model , got the prediction value of total social logistics costs of 2009 and 2010, and made a relational analysis of the prediction value.

According to the statistics of total social logistics costs from 1991to 2008, we created the GM(1,1) prediction model of each component index and made analysis of the transportation cost use the DPS software, got the results of residual analysis in the first time.

Model parameters: a=-0.121 b=3305.841

x(t+1)=30266.269e0.121t+-27387.269

Average deviation is 2.909%

Evaluation of the current model:

C=0.105 good p=1.000 good

Prediction value of transportation cost in 2009: X(19)=30223.788

Prediction value of transportation cost in 2010: X(20)=34101.333 Qmin=-503.99576

The results of residual analysis in the second time： Model parameters:a=-0.057 b=1958.455

x(t+1)=34603.152897e0.057434t+-34099.157141

Average deviation is -4.469%

Evaluation of the current model:

C=0.190 good p=1.000 good

Prediction value of transportation cost in 2009： X(19)= 35150.463

Prediction value of transportation cost in 2010: X(20)=39349.045 Qmin=-6410.305

From the comparison above, we could see that the average deviation percentage of the modified forecast model was small and more accurate. So we selected the second residual results as the prediction model.

In a similar way, we made an analysis of the storage cost, overhead cost and total social logistics costs, got the prediction model as follows.

Table 3. GM (1, 1) Model of Each Series

	Development coefficient -a	Prediction Model x(t+1)	Average Deviation e
Transportation cost	0.057	34603.153e0.057t+-34099.157	-4.469
Storage Cost	0.058	41266.915e0.058t+-40763.476	-11.327
Overhead Cost	0.098	13164.493e0.098t+-12473.493	-4.681
Total Social Logistics Costs	0.047	101354.875e0.047t+-99528.644	-6.133

In the table, '-a'is development coefficient. While -a≦0.3, the accuracy of the first prediction is higher than 98%, and the accuracy is higher than 97% between step 2 to step 5. So it is suitable for medium to long-term prediction. Select 2 as the prediction section and 1 as the residual. In order to check the credibility of the prediction model, we modified and analyzed the residual using the residual test method ,used the original series $X^{(0)} = (X^{(0)}(1), X^{(0)}(2), \cdots, X^{(0)}(n))$ and the relative error $(\Delta(k)=\frac{|X^{(0)}(k)-\hat{X}^{(0)}(k)|}{X^{(0)}(k)}, k=1,2,\cdots,n)$of the fitted value $(\hat{X}^{(0)}=(\hat{X}^{(0)}(1), \hat{X}^{(0)}(2), \cdots, \hat{X}^{(0)}(n))$, to calculate the average relative simulation error $(\overline{\Delta(k)}=\frac{1}{n}\sum_{k=1}^{n}\Delta(k))$。 The average relative simulation error is listed in table 3, the example shows the accuracy is'good', and indicate that the prediction model is credible . Get the prediction value of total social logistics costs and their relevant factors in 2009 and 2010 as showed in table 4.

Table 4. Prediction Value of Total Social Logistics Costs and Relevant Factors in 2009 and 2010 (Billion)

	Transportation Cost	Storage Cost	Overhead Cost	Total Social Logistics Costs
2009	35150.463	24069.015	7164.089	64748.759
2010	39349.045	26817.054	7901.423	72246.377

3.3 Growth Rate Analysis of China's Total Social Logistics Costs

Combine the Guoyan statistics and the prediction value, get growth rate of total social logistics costs in table 5.

Table 5. Growth Rate of Total Social Logistics Costs : 1992-2010

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
18.4	28.7	30.9	24.6	16.4	11.2	2.1	4.7	7.9	7.2
2002	2003	2004	2005	2006	2007	2008	2009	2010	
10.3	13	16.8	12.9	13.5	18.3	16.2	18.7	11.6	

Create the chart of the growth rate of total social logistics costs, 1992-2010

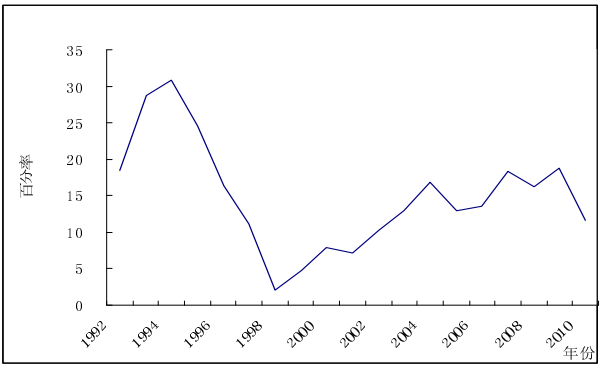

Fig. 1. Growth Rate Curve of Total Social Logistics Costs: 1992-2010

From the graph, we can see that total social logistics grew rapidly in the early 1990s, reached the peak of 30.9% in 1994, and then decreased sharply. In the late of 1990s, it declined to 2.1%. And in the new century, the logistics costs began to rise again, and fell back in 2005 and 2008. According to our prediction value, the growth rate of total social logistics costs will rise by 2.5 percentages in 2009, and appears a downward trend after 2010.It fits the times, because the state has a great input in the early period of logistics stimulus and gradually mature in each aspect later.

3.4 Proportion for Total Social Logistics Costs in GDP

It is known that there are a higher proportion of China's total social logistics costs in GDP. The statistics can be got from the Guoyan website and combine with the prediction value. The chart of the proportion of total social logistics costs in GDP as follows.

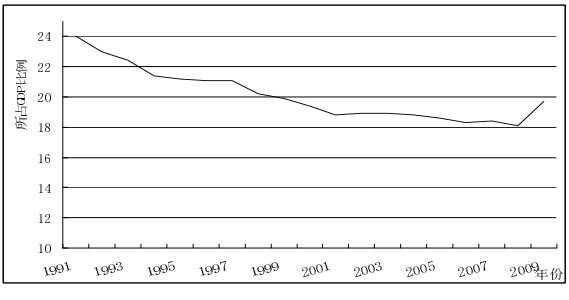

Fig. 2. Proportion of Total Social Logistics Costs in GDP: 1991-2009（%）

From the above diagram, we can see that proportion of total logistics costs in GDP declined gradually since 1991, and fell to 18.1% in 2008.From the prediction value: it will increase to 19.7 in 2009. If it follows this kind of trends, the proportion will

increase to about 20.2% in 2010. However, we believe that the proportion will show a trend of declination since the improve of relevant policy and management methods, and finally achieve the level of developed countries'logistic industry.

4 Conclusion

China's logistics industry started latter than developed countries. The annual expenditure on logistics costs account for a large proportion of GDP. In this case, Chinese governor made a decision of revitalization logistics industry .Today's logistic industry in China turns on a new scene.

- The management methods of China logistic industry improves gradually.
- Training of Logistics personnel, improvements of logistics system and the development of modern logistics.
- The development of logistics information technology.
- The adjustment of industrial structure.

China has great potential in developing logistics industry.Logistics industry will be the key industry and a new economic growth of China in the development of 21st century.Along with the revitalization of the logistics industry and the development of itself, it is credible that the increasing of China's logistics costs will continue to drop down in 2009 and 2010, and it is consistent with the results of the predictions.

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Path Search Algorithms on Service Network under Integrated Transport System

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Abstract. The traditional path search algorithms for single-model transportation network have no application to the integrated transportation network, since there is vast difference between the two kinds of network. In this study, we present novel algorithms for the shortest and k-shortest path search problems under the integrated transportation network. Firstly, the service network structure is processed by considering the coefficients of transit cost weight and time weight respectively, after this work, the list of transit scenes is added to each node information and some artificial nodes are constructed. then the shortest and K-shortest path search algorithms are presented in detail. Further, by analyzing the special character of service network, a new search strategy is proposed which can deal with the transit scenario efficiently and reduce the time cost of the path search algorithms. Examples with different scales of network and OD sets are then given to verify the proposed algorithms. The results prove the efficiency of our proposed approaches.

Keywords: Integrated Transportation system, Service Network, Transit scenario, Shortest Path, K-shortest Path.

1 Introduction

In some decision support systems and consulting systems, besides the shortest path in addition, user also hopes to get second and third shortest paths, etc., according to this kind of requirement, the KSP (*K*-shortest path) becomes an open issue and research area[1], many scholars studied the KSP problem and their research results are very fruitful[2-4]. As the complexity of an integrated freight network, especially because of the transfer weight, the traditional path search algorithm can not be directly applied to the original integrated freight network, we need to make some meaning improvements to original integrated freight network or traditional path search algorithm. Just as Fig.1 shows, according to the traditional idea of Dijstra algorithm, the shortest path of *A* to *C* is *A*-*B*-*C*, then the shortest path of *A* to *D* is *A*-*B*-*C*-*D*, apparently the transit weight on node *C* is not taken into account, the reason is that most traditional search algorithms just record the shortest information in label format, but the KSP problems also needs to record other paths information in the transit node. If you want to record all paths information on according nodes, there is no different from the paths enumeration, we can not afford the solving time. As the traditional path search algorithm can not be applied to original integrated freight network, literature [5]

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proposed a method of splitting nodes, then the new established arcs and nodes will represent all the transit scenarios. Fig.2 represents the split effect of Fig.1. After the split of the network nodes, we can use the classical path search algorithms. However, the splitting method will increase the problem size according the scenarios. And there are always lots of transit scenarios in integrated transport system, under this kind of network, the node splitting method will lead to the network size increasing rapidly, leading to a sharp decline in the efficiency of the path search algorithms. At the same time, the *K*-shortest path search algorithm literature [5] used is not very good mechanism to avoid loops.

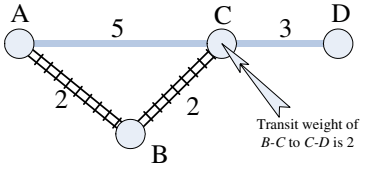

Fig. 1. Traditional integrated transportation system diagram

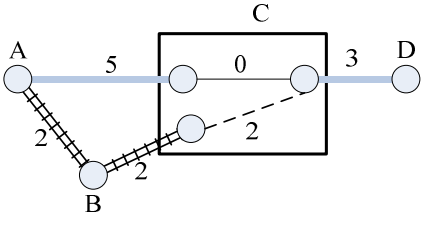

Fig. 2. Node split diagram under integrated transportation system

It is obvious that there are much more transit scenarios in an integrated service transport network than the physical network. At this point, the node splitting method will lead to a sharp increase of problem size in service network under integrated system, the result will make the traditional shortest path search algorithm spending too much time that we can afford. So there is a requirement for us to find a new way to solve the path search algorithms on service network under integrated transport system.

2 Preprocess of Service Network under Integrated Transport Network

For the integrated transport network, the weights we need to take into account mainly means the transport cost and transport time. The transport time can also be transformed to be transport cost by some certain formula. However, from the network dealing process, the weights of transport cost and time still need to be dealt separately. The following first gives the preprocess of weight of transport cost and then gives preprocess of weight of transport time under integrated transport network.

2.1 Preprocess of Cost Weight

For the integrated transport network, since the transport cost on service arc are fixed value, what we need to do is just to deal with the transit weight with different services. This paper proposes a transit cost table to represent the dealing result mentioned above: the table includes several information just as the label information (referred to as T label), its format is (predecessor nodes, predecessor arc, successor arcs, successor node, transfer weight). Fig.3 shows the T label result for integrated service transport network, in which arc name marked on the arc middle, and numbers in brackets means the transport cost value.

2.2 Preprocess of Time Weight

While considering the weight of transport time in service network, we need to not only consider the transport time of the service, but also need to consider the service depart time, especially the transit cost depend on the weight of the original service stop time and the transited service stop and depart time. Based on this, while building a service network, what we first need to do is to label the weight of transport time, referred as L label.

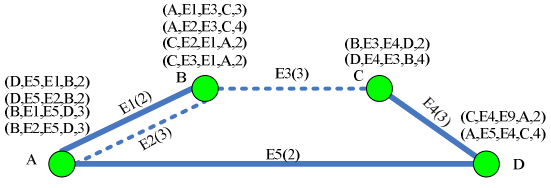

Fig. 3. T label diagram under integrated transportation system

L label first needs to determine a benchmark moment, and then processing the service original station and intermediate stop stations(nodes) as follows: adding a wait arc, the value of time weight for original waiting arc depends on the difference of service original depart time and reference benchmark time, and the value of time weight for stop waiting arc depends on the difference of service depart time and stop time. Fig.4 shows the original integrated transport service network topology. And Fig.5 is the L label result of Fig.4.

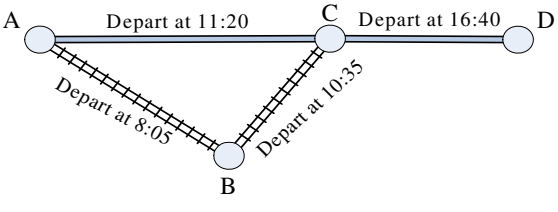

Fig. 4. Service network under integrated transportation system

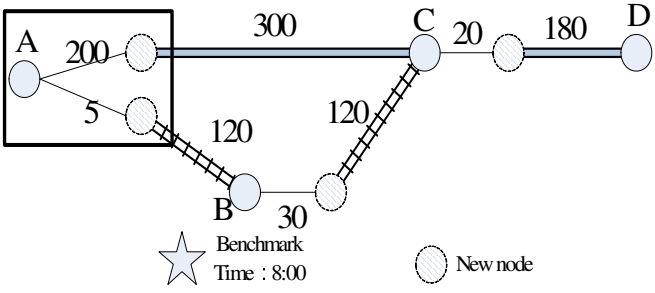

Fig. 5. Processed service network under integrated transportation system

2.3 Weight Using Strategies

2.1 and 2.2 respectively gives preprocess approach for the weights of transport cost and time under integrated transport network. In the path search process, we usually use the following approaches to deal with the weights: (1) considering only one of the weights which is used for the shortest path search algorithm, such as in urban transport which often takes the time weight to search the fastest service path from original node to the destination node; (2) considering two kind of weights one after another, which is often used in the *K*-shortest search algorithm. we often use time weight to get the *K*-time-shortest paths, then we use transport cost weight to get the lowest-cost path in *K*-time-shortest paths to complete the transport; (3) combining two kind of weights to search, which is through a certain transformation formulas to put the time weight into the cost weight. So that two kinds of weight could be represented in a single cost. This idea can be used for the shortest path search and the *K*-shortest path search algorithm.

3 Algorithms

3.1 Shortest Path Search Algorithm

Just as traditional label mechanism idea, our shortest path search algorithm also requires using the label information (we call this process "S label"), and its forms is (predecessor arc, current minimum distance, whether transfer, transfer times).

First, we establishes two sets: C and O. C is used to save the traversed nodes and O is used to save the nodes which were not traversed. The ideas of the improved shortest algorithm is shown as follows:

Step1. Setting the starting node s in set C.

Step2. Traversing the non-taboo adjacent arcs composed by all adjacent nodes of the starting node s in set O (we can call this kind of arc as "non-taboo adjacent arc" in set O). Set S label information of terminal node u of the adjacent arc which has the minimum adjacent weight. Because we have to deal with to the influence of transfer weight here. After setting S label information to node u, traversing all non-taboo adjacent arcs of the u in set O, and setting S label information to the follow-up node which is the same type as preorder arc on the node u (in the S label information). Then continued to traverse follow-up nodes, and repeating this labeling process until the arc

of the same type does not exist. Setting the node u in set C. This procedure is called pre-search.

Step3. Traversing the non-taboo adjacent arcs of the node u in set O, and selecting the adjacent arc which has the minimum weight that arc throughout weight plus the transfer weight. Then set S label information to the terminal node f of the adjacent arc, and set the node f in the set C. Because of interference factor of the transfer weight here. The procedure of pre-search on traversing follow-up nodes of node f is operated just as described in Step2.

Step4. Updating the information of node u to the node f. Then determine whether set O is empty. If the set O is empty, the algorithm will stop. Otherwise, turn to Step3.

3.2 *K*-shortest Path Search Algorithm

Step 1. Determine the starting node *s* and terminal node *t*. Then setting all nodes in the set O, and emptying the taboo information of all nodes and the candidate path set H.

Step 2. Using the shortest path algorithm mentioned above to find the shortest path P between the node *s* and the node *t*, and adding taboo information to all nodes except the terminal node on the path P.

Step 3. To traverse each node in the path P from the terminal node. If the out-degree of the node is greater than 1, setting all nodes form the starting node to this node in the set C (avoiding circuit). Using the shortest path algorithm mentioned above to search the shortest path from this node to the terminal node, and combined the shortest path from the starting node to this node to compose the candidate shortest path, then adding to the candidate path set H.

Step 4. If the set H is not empty, selecting the path which has the minimum weight in the set H as the k short-circuit, and *k* plus 1. Determine whether *k* equals to K. If *k* equals K, the searching process ends. If *k* is less than K, it should determine whether the set H is empty. If H is empty, it means that there are only *k* shortest paths. Then it should turn to Step1 to continue to the next path search. Otherwise, making the P set to U, and turn to Step3.

3.3 Updating Strategies

What need to be noted here is that in 3.1, pre-search in Step2 is the key point, though it deals the influence of transit weight, but at the same time it leads to more updating operations, this process also increases time complexity. There is a very outstanding feature for path search in integrated service transport network: if a node on service line do not have transit scenario yet, then all the follow-up nodes on service line do not need to be dealt with pre-search. Because of this consideration, it can be easily known that during integrated transport service network: (1) the non-stop service is the best, in the path search, non-stop service means all the service arcs in this service line only need one time of pre-search; (2) Whether passenger transport field or freight transport field, reasonable transit times on one transport route is no more than 3, in passenger field, even when transfer time is 3, passenger often feel very tired, it means the times of pre-search should be generally no more than 3 in each path search.

Because of these features, in Step2 of 3.1,only when there is transit scene happens on node, then we operate the pre-search process for the follow-up nodes belong to the service which subsequent arc belongs to, otherwise we do not deal the pre-search process.

3.4 Algorithm Time Complexity

The efficiency of deviation algorithm depends on the number of deviation times and the time complexity of shortest path algorithm. For an integrated transport service network, the number of deviation times depends on the hubs, this means that the number of deviation times mainly associated with the network structure. The time complexity of shortest path algorithm is just reflected in more update steps for pre-search process. For any node, the number of update times is related to the follow-up nodes of the same services line. The characteristic of an integrated transport services network is precisely that ,to the worst condition, any service in general also need only three times. That means we just need *n* more times update complexity than Dijstra algorithm.

4 Case

We develop the algorithms proposed above by c# on Visual Studio platform. The case here uses the formula below to combine the weights of transport cost and time to operate the *K*-shortest path search algorithm. $\cos t^{W}_{i,j,s,d}$ represents the transport cost weight between node *i* and *j*(including the transit cost). $\cos t^{T}_{i,j,s,d}$ means the transport time weight. So the integrated weight *C* is:

$$C = w_1 * \cos t^{W}_{i,j,s,d} + w_2 * \cos t^{T}_{i,j,s,d} * \xi_{i,j,s} \circ$$

w_1 and w_2 is the coefficient factors, $w_1 + w_2 = 1$. $\xi_{i,j,s}$ represents the transform factor from transport time to transport cost. The case set $w_1 = w_2 = 0.5$. And the value of $\xi_{i,j,s}$ is different for each service arc.

We have test the algorithm on different cases, the network for our case is constructed based on Chinese railway network. Then we construct the road transport service and airline transport service based on it. The largest scale of our case includes 1000 nodes. After many times test, we list the path search time for each scenario we design in Table.1

Table 1. Efficiency of proposed path search algorithms for examples of different scales

Node Amount	OD Amount	Arc Amount	Average Transit Times	Transport modes included	Average Search time
50	30	162	0.12, 0.32	rail、road	51ms, 580ms
100	50	465	0.17, 0.82	rail、road	87ms, 974ms
300	100	752	0.31, 1.12	rail、road、airline	397ms, 2.2s
1000	500	2526	0.53, 1.08	rail、road、airline	2.3s, 26s

5 Conclusion

This paper studies the path search algorithms under integrated transport system. According the feature of service network, we propose the label method, and then we propose improved shortest path and *K*-shortest path search algorithms. We set the update strategies according to the service network feature. The case verifies the algorithms.

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Applications of GPS in Grain Logistics Management Information System

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Abstract. For the problems of real-time transmission and application of the grain logistics vehicle information, the grain logistics vehicle information collection can be realized by means of GPS, SMS and windows service. And the management and application of the grain logistics vehicle information can be realized in virtue of the platform of management information system and the geographic information system. Test results show that the grain logistics information can be managed and monitored conveniently and effectively with this method.

Keywords: Grain Logistics, GPS, SMS, Windows service.

1 Introduction

Grain is an important commodity relative to people's livelihood. The grain commodity's circulation process is unique because its amount is normally large, its complicated correlations with other industries, etc. In 2007, the Chinese national development and reform committee issued the "modern grain logistics development plan". The plan presented to develop the modern grain logistics, realize the change of store, transport, load and unload of bulk grain, improve levels of automation, systematization and facilities modernization of grain circulation, which is of great significance to improve the efficiency of grain circulation, reduce the cost of grain circulation and ensure the safety of national grain.

Grain logistics management information system integrates the global positioning satellite technology, the geographic information system technology and the modern communication technology as a whole, through smart phone with GPS function, sends real-time position, speed and direction information of grain vehicles to monitoring center in SMS mode. The system can display and playback the target movement tracks in the geographic information electronic map. It still has functions of monitoring and inquiring for the position, speed and direction information of grain vehicle. It provide visualization interface for grain logistics dispatching management, and improves the operation efficiency of grain vehicles.

In this paper, some key problems of GPS technology which is applied in the grain logistics management information system are studied.

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2 System Architecture

The system includes smart phone terminal system and the monitoring center system. The monitoring center includes management information system and geographic information system. In addition, it needs constituent parts including GSM MODEM, communication server and database server to complete the complete system function. The system architecture is shown in Figure 1.

Smart phone terminal system, management information system and geographic information system respectively interact with database server. Such architecture has the characteristic of low coupling and can be easily extended.

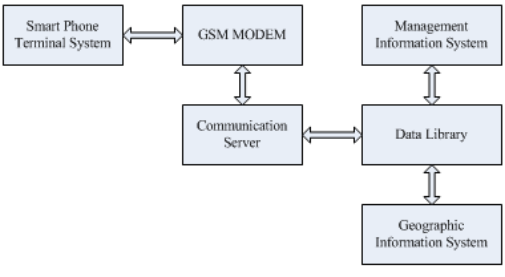

Fig. 1. System architecture

The smart phone terminal system has such functions as grain vehicle's GPS information collection when grain is loaded, grain vehicle is moving and grain is unloaded. The monitoring center is responsible for sending schedule information and receiving reply information from smart phone. Furthermore, it can realize monitoring the grain vehicle's position when grain is being loaded, unloaded and in transit.

3 Application of GPS in Grain Logistics

3.1 System Development Environment

The system adopts smart phone with Windows mobile 6.0 operating system and GPS module, GSM MODEM with WAVECOM core module, Microsoft Visual Studio.NET 2005 and Microsoft SQL Server 2005. The development software is selected as C# computer language.

3.2 GPS Operating Principle and Data Format

The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. The current GPS consists of three major segments. These are the space segment (SS), a control segment (CS), and a user segment (US).

GPS satellites broadcast signals from space, and each GPS receiver uses these signals to calculate its three-dimensional location (latitude, longitude, and altitude) and the current time. Satellites and receivers generate duplicate radio signals at exactly the same time. As satellite signals travel at the speed of light (186,000 miles per second), they take a few hundredths of a second to reach the GPS receiver. when a receiver gets this information, he can calculate his 3D position, directions, move speed and time information.

The GPS receiver's software interface protocol is NMEA0183 ASCII code protocol established by the US national ocean electronics association (NMEA). The NMEA statement begins with ASCII code '$' and end with '<CR><LF>'. the data fields of statements are separated by comma. there is checkout sign (hh) at the end of statement. The checksum is the exclusive OR of all characters between the "$" and "*".

The smart phone gets GPS data by means of GPRMC sentence. GPRMC statement format and the meanings of all fields are described as follows.

$GPRMC,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>*hh<CR><LF>

(1) Greenwich mean time of the current position, format is "hhmmss".
(2) Status, A is valid location, V is invalid receiving warning.
(3) Latitude, format is "ddmm.mmmm".
(4) Marking north and south hemisphere, N is the northern hemisphere, S is the southern hemisphere.
(5) Longitude, format is "dddmm.mmmm".
(6) Marking east and west hemisphere, E is the east hemisphere, W is the west hemisphere.
(7) The ground speed, range is from 0.0 to 999.9.
(8) Azimuth, range is from 000.0 to 359.9℃.
(9) Date, format is 'ddmmyy'.
(10) Geomagnetic variation, from 0 to 180.0℃.
(11) Geomagnetic variation directions, E or W.

3.3 Collection of GPS Information

GPS module of smart phone receives satellite information, analyses NMEA grammar through the GPSID (GPS intermediate driver) and obtains GPS information such as longitude, latitude, speed and direction. The principle is shown in Figure 2.

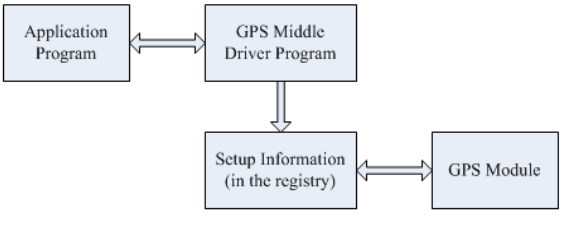

Fig. 2. Schematic diagram of obtaining GPS information

When the smart phone terminal agrees scheduling instructions, it can send GPS information of grain vehicle to monitoring center. The GPS information of grain vehicle includes GPS information when the grain goods are loaded, transported and unloaded. To distinguish them, we increase a discriminate sign bit: 1 represents for loading, 2 for transporting and 3 for unloading. The separator between each two fields of GPS information content of grain vehicle is defined as '/'.

The protocol of GPS information content of grain vehicles is described as follows.

1/transportation contract number/the longitude of loading site/ the latitude of loading site/loading weighing/car number;

2/transportation contract number/the longitude of transport process/the latitude of transport process/direction/car number;

3/transportation contract number/the longitude of unloading site/the latitude of unloading site/unloading weighing/car number.

Take a GPS information message of grain vehicle in the process of transportation as an example.

|2#04#86187********#2/2010091001/113.544305/34.831813333333/189.51/ 豫 A-00036#10-8-15 14:30:12,

among it,

"2/2010091001/113.544305/34.831813333333/189.51/ 豫 A-00036" is GPS information of grain vehicle, which includes such fields as information sign bit, transportation contract number, the longitude and latitude of grain vehicle, the movement direction of grain vehicle and the car number.

3.4 Transmission of GPS Information

The smart phone realizes sending grain logistics messages through the follow steps. First, start grain logistics management software of smart phone terminal. Software program will read automatically grain logistics information from message inbox, analysis contact phone number, transportation contract number, GPS sending time interval and other information. then, send grain logistics information by invoking the SMS sending function.

Smart phone receive grain logistics messages by using its own SMS receiving function.

Communication server realizes sending and receiving grain logistics messages by calling dynamic connection library of GSM MODEM with windows service mode. The sending messages are stored in a queue. when the queue has sending messages, communication server reads the messages in the queue one by one, and sends messages by calling SMS sending function of the dynamic-link libraries of GSM MODEM. If sending successfully, communication server adds message to a list of sending successful; otherwise, adds message to a list of sending unsuccessful. When receiving the new message, communication server reads the new message content by calling SMS receiving function of the dynamic-link libraries of GSM MODEM, and judge the message is legal or not. If the message is legal, adds message to the list of receiving message, and delete the receiving message of SIM card, otherwise, delete directly the receiving message of SIM card.

3.5 Management of GPS Information

The scheduling information, which is transmitted by management information system platform, includes dispatching information of loading and unloading grain, and GPS dispatching information in the transport process of grain vehicles. First, management information system platform generates a scheduling message of loading and unloading grain, sends scheduling message to smart phone terminal through GSM MODEM, and then waits for the smart phone terminal confirm scheduling message. When receive the confirmation message from smart phone terminal, management information system platform sends to the smart phone terminal automatically a reply message. Only when receiving the agreeable scheduling message coming from smart phone terminal, the platform is allowed to send GPS dispatching information of in the to smart phone terminal.

Geographic information system platform is mainly responsible for obtaining the GPS data of vehicle, and show the motion trail in the electronic map. The system transforms abstract space geographic data into visual map graphics. Furthermore, the information can be browsed, operated and analyzed. The aim is to realize real-time monitoring of grain logistics information.

4 Summary

In this paper, we use smart phone with GPS function obtaining the longitude, latitude and direction information of grain logistics vehicles. The information transmission of grain logistics is realized by means of SMS and Windows service. The management and application of GPS information of grain vehicles is fulfilled through the management information system platform and the geographic information system platform. Test results show that applying GPS technology to grain logistics management information system can effectively and real-time realize monitoring the grain logistics information.

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Strategy on Network Marketing Channel of Apparel Business

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Abstract. With the popularization of information technology and the rapid development of network technology, people are more and more familiar with network, it covers every corner of the world,and it has become the important component of modern life style in the developed countries and regions. In another word,network market as the space for transactions, it is another revolution in transactions.For traditional costume market,e-commerce transactions has become a new way of transaction.Compared with the traditional clothing sales mode, internet clothing sales has lots of incomparable advantages, but also faces obstacles.Based on the present situation of clothing network marketing,this paper analyzed the feasibility and necessity of the on-line marketing in the apparel enterprises. Finally this paper put forward the network marketing strategy based on the network marketing environment.

Keywords: internet marketing, apparel business, marketing strategy, information, channels.

1 Introduction

For 30 years of reform and opening up, garment industry has been rapid development. On an annual average rate of 14.5%, higher than the average GDP growth of 9.5% higher than 5 percentage points, becoming the fastest growing during this period, the largest foreign exchange earning, the most close to people's lives, one of the industries most worldwide attention. The apparel sales have continued to grow rapidly, while the whole country is much room for clothing sales.

As the global market opening, foreign brands into China one after another, the domestic garment enterprises will face tough competition situation. China is facing a power shift from apparel clothing powers made the critical period, how to seize opportunities, meet challenges and enhance the competitiveness of enterprises has become a major issue facing the garment. At the same time, channel management is increasingly becoming the core marketing management 2l century, enterprises gain a competitive advantage is an important strategic weapon, which should attract enough attention to the clothing company.

Marketing channels of great significance for the clothing business. First, the marketing channels is an important part of brand marketing strategy is an important asset of enterprises, an enterprise product to consumers through the process of transfer

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of the path, including the company established its own sales offices, agents, distributors, retail and other related parts.

Secondly, the goods and services can quickly and smoothly reach the hands of customers, channel playing an increasingly important role. The garment industry is highly endemic and seasonal industries, channels of smooth particularly important, therefore, marketing channel management critical to long-term development of enterprises.

Thirdly, different industries, different products, different sizes, forms of marketing channels are not the same company in a short time to market a new product, it can not build in a short time channel, without a good channel can not make the same sales success, so channels affect the competitiveness of garment, garment bearing the success or failure.

Therefore, the marketing channels mix strategy is an important part of the strategy. Apparel Marketing channels will directly affect the choice of other marketing decisions, such as product pricing. The face of fierce market competition, how in the fierce market competition, with the fastest speed and breadth of marketing, the products and services quickly and easily passed to customers, access to marketing channels play a decisive competitive advantage has been an important factor. As the clothing and fashion as a highly epidemic of goods, factors are more complex marketing channel, so the right choice and manage the marketing channels of the clothing company clothing is essential.

In summary, the study of fashion marketing channels has important theoretical meaning and practical significance.

2 Problems of Internet Marketing

Although network marketing has significant advantages and attractive prospects, but at this stage still a lot of bottlenecks to be resolved. In recent years, the failure of many domestic and international Internet marketing tips on people, development and stability in the garment industry to a broad customer base, take a very long time. Because aspects of the apparel industry itself has its own characteristics, speed of network marketing in the apparel development, many problems also will show up.

2.1 Line Fitting

Clothing as a traditional retail purchase common way is to try before buy clothes, customers always want to first go through a trial wear, touch fabrics to determine the styles, models, whether with their own style, temperament, color, size and other match, which is working with the current Internet can not try on clothes buying patterns contrary. Clothing provided by network marketing is a virtual market, clothing sales on the Internet, the most prominent problem is that consumers can try on the web. If the customer can not buy clothes online with full confidence, it will make their way online to purchase clothing to produce a sense of resistance, which increases the difficulty of online sales of clothing, seriously affected the development of internet sales.

2.2 After-Sales Service

This is mainly reflected in the return and replacement of inconvenient to the consumer to purchase the clothing can not be received in time and so on. Many consumers reluctant to buy clothing online because of worries to buy clothing is inappropriate, and refund or replacement will bring more trouble. Many foreign Web sites selling apparel to consumers an unconditional commitment to retire, replacement, and domestic online clothing sales have retreated, and replacement of the commitment to small, and commitment to unconditional return replacement of less and less.

2.3 Logistics and Distribution

Online shopping consumers are very concerned about how long to receive the clothing, which relates to logistics and distribution system. For logistics and distribution systems, including express delivery company to complete the traditional tasks, however, China's logistics systems and logistics systems to international standards than there are big difference between the foreign use of computer technology is mature, using internationally accepted trading in the according to price priority, time priority, the priority of the principle of system resources, a computer automatically match transactions, completed off-site and remote cargo transport. Domestic use or primitive technology, it is no exaggeration to say that China's logistics level equivalent to 30 years developed the level of the 20th century. Therefore, we can see that lag the rapid development of logistics and incompatible network marketing, logistics and distribution network of the problem has become another obstacle to clothing sales.

2.4 On-Line Payment

Both transactions on the Internet only through the network to communicate, negotiate, confirm, the last to deal, in the final trading, online banking as an important role. Deal directly online, through bank credit card online payment to complete. The current national network of specialized banks have chosen not unified communications platform, is not conducive to cross-bank connectivity between banks and the central bank finance and regulation, as well as macro-control policy implementation.

2.5 Security Issues

Security is the largest apparel network marketing, security content, including information security and network system security in two parts. Information security is directly related to consumer privacy. Now, if consumers directly online shopping, personal information is likely to be stolen, the electronic bank account where the money may be cracked by criminals to steal passwords, personal information is likely to rent or sell to other institutions, consumer are very likely to face numerous spam and nuisance calls, which seriously infringe the personal privacy of consumers.

2.6 Web Content and Functionality

Feature set depends on the company website the purpose of building websites, site functionality and then determine the content of the site. Company web site should not

be just a decoration, but to promote enterprise, display products, building customer relationships and develop new markets. Online sales is not necessarily a complete e-commerce, but it should be the most useful marketing tool.The main task of network marketing online and offline site promotion, the majority of Chinese clothing site working poor in this regard, attention is not enough, invest less, means less, the effect of natural differences. If the garment through the necessary inputs to take full advantage of search engine registration and ranking of online advertising, marketing, mailing lists, information networks, and classified ads.Internet marketing methods and methods to conduct online marketing business.

3 Analysis of the Feasibility and Necessity

3.1 Feasibility

Compared with the traditional marketing network marketing, the environment has changed dramatically. The scope of network marketing sales exceeded the original scope and consumers by commodity groups, geographical location and convenient transportation mode of delimitation of marketing, technology, rapid development has greatly reduced the time and space.The profound changes brought about by the Internet marketing environment for the implementation of network marketing companies offer great potential .

Internet marketing strategy is also subject to its political and legal environment. Government information technology and e-business attitude and policies put pressure on Internet operation and power source. Government information technology and e-commerce attention and support for the development of network marketing brought good opportunities for development.

Because network marketing is a new commercial, currently involved in network marketing, privacy issues, cybersquatting issues, electronic signatures, and the hacker violated the laws of such issues can not be resolved in the old, need to be a new legal system establishment. China is constantly improving the relevant legal system.

The rapid development of internet, causing a huge cultural impact the environment and to create a unique Internet culture. It penetrated into every corner of the world and all aspects of people's lives, creating new demand and people's life and work had a tremendous impact. Compared with the traditional culture, internet culture has its uniqueness.

3.2 Necessity

Network economic environment, including market-end consumer behavior, including both the market place changes, these changes will certainly bring clothing company's mode of operation profound changes.

First of all, in the network economy can not only show the brand, you can create a brand, rebuild the brand image, brand development resources. Network is the strength of the brand dominating the market of the era, the brand will become the core competitiveness of enterprises. Therefore, the garment must shift the focus of the work to the brand construction. Secondly, the nature of the market. Network economy, consumers, and according to the vast amount of information to make their

own choices, the initiative has been slow to grasp the hands of consumers. Finally, a virtual business.Along with the rapid development of market economy, the traditional marketing channels in the channel management, channel structure, channel relations, and environmental adaptability, which demonstrated characteristics impede the development of enterprises.

With the end of the retail channel growing power, channel intermediaries mastered the sales and customer demand the most comprehensive and direct information, thus increasing the clothing manufacturer bargaining chip, the manufacturer's profitability a great deal of pressure. Marketing channels in the power structure gradually tilted to the end, the loyalty of brokers down, apparel manufacturers find it difficult to effectively manage the channel. Second, the cost. As the level of more traditional marketing channels to enhance the product's marketing costs, and manufacturing products in the fierce competition in the market at a disadvantage. Finally, adaptability. In the network era, consumers generally want transcend time and space distribution channels, efficient, convenient, safe and other functions, right garment enterprises of the channel strategy put forward new demands.

4 Strategy

4.1 Marketing Channels

Network marketing channels refers to information technology in the network, represented under the conditions of each marketing channel mode selection.

Market competition in the network marketing was to gain the advantage, major Internet portals continue to strengthen the marketing channel construction, and strive to realize the diversification of online marketing channels. The success of marketing channel relationship building to the service provider market competitiveness, with smooth, reliable sales channel, has become the key to win the market. Channel support will make a huge Internet companies to provide customers a full range of services to become a reality, during a huge commercial value, leading gradually to the real gateway to the Internet economy business forward. With a strong network of support under the physical distribution network, the Internet can be relatively easy to achieve business from product provider to service provider changes. In the high-growth market environment, the channel agents play an important role.

However, the decisive impetus to the market or technology, the rise of search engine in China is likely to be a comprehensive network in China was a watershed in the history of marketing. Moreover, the search engine as the core technology of the Internet, search engine business applications into a more competitive era, for the layout of the entire network marketing market also produced strong shocks, are more likely to re-shuffle the old pattern. Major portal sites or service providers should strengthen the overall marketing system as soon as possible, especially to strengthen control and management of marketing channels. Such as CDC, TOM, 8848, etc. are also constantly searching for new forces to strengthen its own brand, as one who has mastered the channel will come to rule the roost in this changing situation with the capital. Portal to provide Internet marketing products or service providers and channel complexity of the relationship between enterprises, both mutually dependent on each

other constraints, the agents need to rely on service providers of products and the agent's effort determines the service provider's revenue, while agents their own future in its hands in the hands of service providers, which in itself does not have the key products and core competitiveness. For the gateway, on one hand to absorb the channels to do their own products, other agents appear to prevent irregularities in the normal operation of the destruction of channel sales order.

Therefore, the upstream service providers, the competitiveness of its key channels control how, is how to further improve the channel that is loyalty. Marketing channels and service providers from the tightness of view, the general service marketing channels can be divided into three levels: the first level of the core marketing channels, such marketing channels mainly refers to the core of the major areas or exclusive agent ; the second level for the sub-body of marketing channels, such channels is mainly refers to the core agents or distributors under the exclusive distribution channel; third level of the external marketing channels, which mainly refers to the special marketing and a variety of different Department agency points.Through marketing channels to increase the allocation of resources, carefully selected partners, improve the structure of the overall marketing system and other methods can indeed improve the loyalty and control channel capacity, but service providers to further integration of channel resources, in particular, increased channel management efforts and policy support, it will be more effective.

4.2 Payment and Delivery Methods

Online marketing can not do without the strong support online financial. Online payment is a systematic, require banks, merchants, consumers, and information technology companies on joint participation of the lack of any link does not function properly run. On the one hand, by offering to pay the merchant bank card to pay a fee to banks, so some businesses do not want or prohibit customers to pay online by bank card. On the other hand, online consumers in the first online payment business, some banks have asked me to place of business in person to the bank opened the business with relevant documents, which virtually has increased by an online transaction procedures. The same time, online shopping, the Internet users on the network security is also a great concern, such as the user's personal information, bank account passwords transaction process, the process of funds transfer security.

Logistics is the biggest bottleneck in the development of network marketing lies. The so-called logistics refers to the plan, implementation and control of raw materials and finished products from origin to point of use of the actual process, and based on the profit to meet customer needs. The role is to manage the logistics supply chain, from suppliers to end users added value processes. Internet Marketing by reducing the lower middle part of the cost, so that it can offer more favorable price, if not properly handled logistics, may make the cost savings are insufficient to cover shipping costs.

4.3 Website of Clothing Company

For the apparel business, the plan can be based on the company's image and brand marketing ideas, website promotion company website set up, according to the characteristics of the online sales of goods, brand concept, design, or simple or serious

and solemn and bright pages. Content in the web design should take into account the following: Introduction:This section includes company background, history and organizational structure to enable visitors to the company's situation to have a general understanding, as on the Internet to promote the company's first step, it may be a very important step. Product Catalog: To provide products and services, electronic catalogs, customer-friendly online search. New description: strong seasonal clothing, the company's new clothes only to be included in the catalog, and to do special exhibition.Trends: collection of international and domestic clothing trends, and the understanding and use of the company have also announced together. Site recommends: together with industry and other business related sites to provide users with the convenience check. This will not only attract users, while their hearts are set a good image of good service.

5 Conclusions

The traditional marketing channels garment enterprises will gradually use network technology to achieve the Internet marketing channels and the integration of traditional marketing channels. Network marketing channels in the future will further the theory of innovation and practice, practice to test the feasibility of using the degree of the theory in practice and gradually improved. This article studies the background and significance, combining with very representative of many in the academic theory, collect some for study data to create value for our internet marketing of the channel of clothing to make some research. The channels from the network theory of the beginning, this paper describes the meaning of online marketing channels and classification and characteristics of the clothing enterprises from the status of network marketing to analyze.

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Modeling of CAD System Based on Features

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Abstract. This paper brings forward a method for modeling of CAD system based on features for the purpose of meeting the requirement about CAD system, The features of the system are defined by rule and line. The some data structure models are made accordingly. The method is applied to HIT-2 design system with integration of CAD and CAPP. Through many examples, the result shows that the modeling method has effective and high practical application value.

Keywords: Feature, CAD, Part, Data structure.

1 Introduction

Mechanical parts of the product design process and manufacturing process are the complex process to handle information, to realize the integration of CAD/CAPP system, we need to change all of the information to the reasonable way that the computer can accept and deal with.

After many years of the home and abroad experts' research, we have got many advances in expression of products information for example, the establishment of knowledge standards and expert system's research and so on, especially information extraction has created a common perspective basically, consider feature is the basic elements of information expression. This paper on the basis of the home and abroad experts' research puts forward the modeling method which based on the characteristics of the system data, to define the characteristics of the system and to build data structures' mold, the method used in CAD and CAPP integrating system means HIT-2 system and the method is proved to be effective and have the practical value[1-5].

2 Definition of Shape Features

Shape features is the special shape that is composed with a group of geometric elements (dot, line, face) with topological relation in the production, it has a specific function and matches with the fixed processing method, is suitable to be used in design, analysis and manufacturing.

After many years of research based on feature design, found: ① Shape features need to accept the data structure with the face as the main part. Every face has the special semantic information and need explicit retrieve and reference; ② Shape features is not necessary to be the closed entity, it can be composed with several faces; ③ Machine elements can be made by a large number of shape features by simple joint

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and subtracting operation(As shown in Fig.1. The part is composed with feature1 jointing the feature2, and the feature3 using the Boolean difference operation).

Every surface list belonging to shape feature explicitly lists every characteristic of this feature. Characteristic face has many kinds of property for example, the order number, face type, surface roughness, etc.

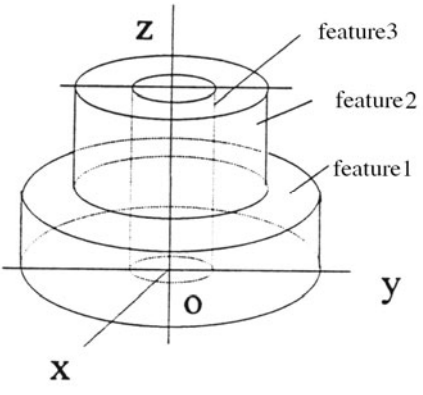

Fig. 1. Part composed joint and subtracting operation

3 The Data Structure of Master Model

The criterion is very important in the product design, first of all the product size is expressed according to the definition of criterion. Then tolerances (including dimension tolerances, shape tolerances and position tolerances) should also be expressed definition comparing to criterion. This paper designed the data structure of master model as shown in Fig.2.

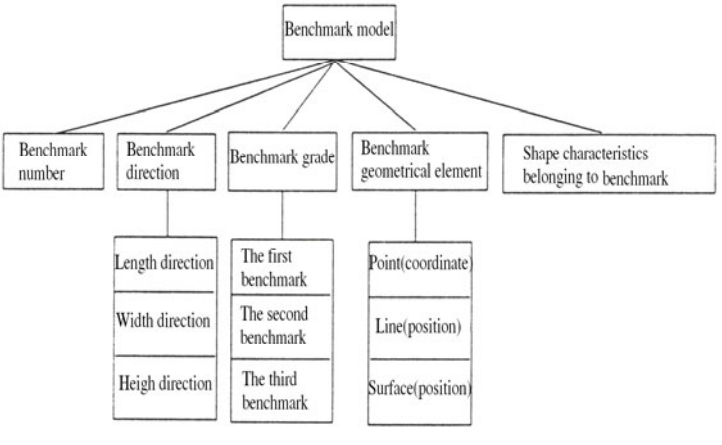

Fig. 2. The data structure of master model

The criterion is defined in three mutually perpendicular directions, each direction has one major criterion (defined the first criterion) and two supportive criterions (defined the second and the third criterion respectively, they directly contact with the first criterion), if there is no supportive criterion, the second and the third criterion are undefined. If there is only one supportive criterion, the third criterion is undefined. If there are two or more supportive criterion, just consider the two major criterions, the rest is covered at later time.

4 Expression of the Dimension

About the dimension, firstly the size dimension of shape feature is defined, then the location dimension is defined, they are all shown in the model of the shape feature and data structure in the unify way.

The size dimension: In shape feature library, each shape characteristics is given its parameter. For example, outside cylinder is given the length and radius, when the user is defining, he just need to set the size to complete the representation of size dimensions.

The location dimension: In the data structure of shape feature, expressed by the origin of coordinates and coordinates Angle between local coordinates and the parts' outer dimension which belong to the Datum Coordinate System.

5 Part Design Based on Shape Feature

Using the joint and Boolean difference operation to achieve the part design based on shape feature.

Joint is used in geometric entities shape characteristics of the operation, Boolean difference operation is used in the operation between the geometric entities shape features and the nonbasic geometric entities shape features.

The process of part design based on shape feature can be expressed by data structure of binary tree, this is helpful to process' retrieve and record, to add and to cut the shape feature, the structure as shown in Fig.3.

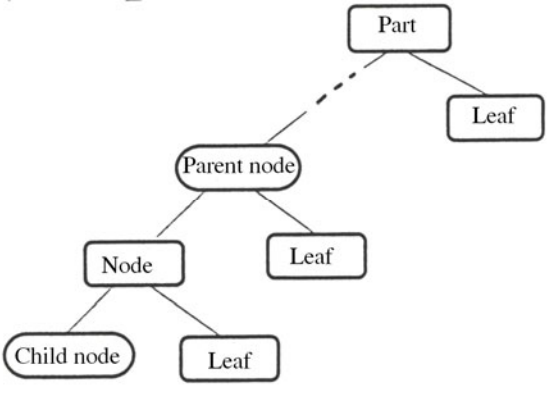

Fig. 3. Design of parts shape based on the shape feature

Each node contains the node number to link the operation, the type of connection and serial number of connecting face, leaf nodes (the connected features number), pointer of the parent node and the children node.

6 Expression of the Tolerance Feature

In the manufacturing process of the parts, tolerance features support the machining, assembling, testing, quality monitoring and many other need, this kind of application which need this information, especially the need of CAPP to apply.

6.1 Expression of the Form Tolerances

In addition to the line profile and the surface profile refer to association elements, the other type of form tolerances have no relation with the benchmark system. The data structure model of form tolerances as shown in Fig. 4.

6.2 Expression of the Location Tolerances

The data structure model of location tolerances as shown in Fig. 5, the benchmark elements contain the single benchmark, double benchmark composited benchmark, three benchmark and composited benchmark to be chosen.

6.3 Expression of the Dimensional Tolerances

Dimensional tolerances is the allowed alteration of size, the involved geometric elements has been contained in the dimensions. The data structure model of dimensional tolerances as shown in Fig. 6.

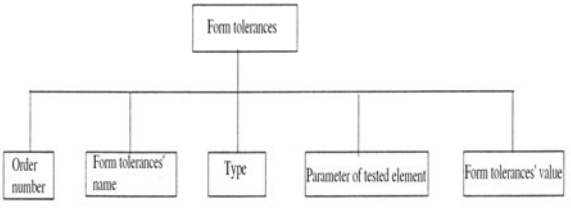

Fig. 4. The data structure of form tolerances

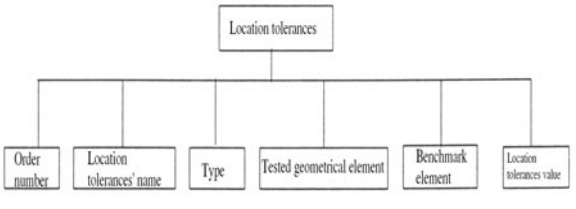

Fig. 5. The data location of form tolerances

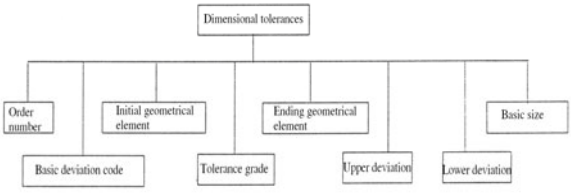

Fig. 6. The data dimensional of form tolerances

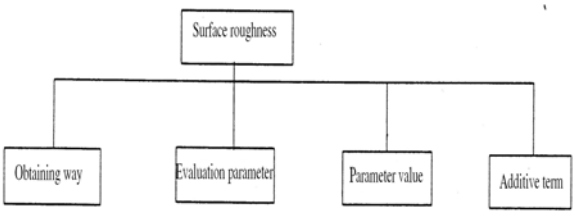

Fig. 7. The data structure of surface roughness

6.4 The Expression of the Surface Roughness

The surface roughness reflects the surface micro-geometry error of some surface feature, which has nothing to do with the Benchmark system., the data model of the surface roughness as shown in Fig. 8.

7 The Expression of the Technical Characteristics

7.1 The Feature of Material Information

The feature of material information data unit indicated in this paper includes name of the materials, material grades, blank type, mechanical behavior parameter document, physical properties parameter document, chemical properties parameter document, processing properties parameter document.

7.2 The Feature of Heat Treatment Information

The feature of heat treatment information data unit indicated in this paper includes the type and the method of heat treatment, surface hardness(HRC), heat treatment object and other requirements.

The heat treatment type includes Bulk heat-treatment, case heat-treatment and surface heat treatment. The method of heat treatment includes anneal, normalization, tempering, quenching, oil quenching, high frequency quenching, Conditioning high-frequency quenching, flame hardening, nitridation, carburizing and quenching, carburizing and high-frequency quenching.

8 The Expression of Parts Ancillary Information

The ancillary information of parts mainly indicates the information required by the management of parts product document. Its data unit includes the Balloons and names of parts, designer, design organization, maker, manufacture company, design date, manufacture date, single weight, batch, outer dimension, product maintenance and transportation instructions, etc.

9 Modeling of CAD Based on Features

In the foundation of all characteristics' data structure model, this paper set up the CAD data model basing the feature, as shown in Fig. 8.

The data model adopts the multi-branches tree, using the pointer to index and invoke the feature from the library.

This paper established the HIT-2 software interfacing the APP with the data model, and it has been proven to be effective in the actual application.

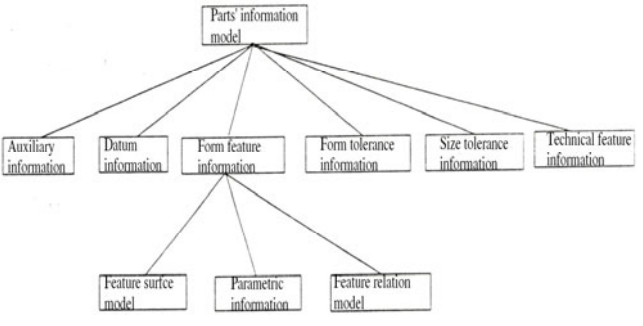

Fig. 8. The data structure of part

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Study on the Parameters of Trip Distance Distribution Model for Rural Population

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Abstract. To obtain the parameters of trip distance distribution model for rural population, analyse the influence factors, select the different factors as the regression analysis of parameters,and get the account formula of each parameter.to test the correctness of formulas,the dataes of trip distance for rural population in Baoji city was selected, The result shows that the maximal absolute error between statistical data and computational values is 4.8%,so the parameters formulas and trip distance distribution has high accuracy.

Keywords: traffic planning, rural population, trip distance, parameter.

1 Introduction

The trip distance of the rural population is the main aspects of trip characteristic, which can offer important decision basis for new countryside construction, regional traffic planning and establish the line of passenger transport for rural population.

The main method including Gamma model[1-2], negative exponential model[3], Second-order Erlangian Distributed model[4-5]and Rayleigh Distribution model[6] to research the trip distance distribution for population.but the object and application scope were limited to urban inhabitant.

The trip distance distribution model for rural population were given by Liu Haoxue and Feng zhongxiang[7] to research the trip distance distribution for rural population,the model were exported by advanced mathematics-related knowledge based on a great number of trip dataes for rural population, which can describe the commonly distributing and show the rule of trip distance for rural population.

Whereas the limitation of the sample value, the parameters must be modified to make the model be practicability extensively.

2 Trip Distance Distribution Model for Rural Population

Liu Haoxue and Feng Zhongxiang[7] put forward the trip distance distribution model for rural population as follow:

$$F(r) = 1 - \exp(\alpha r^{-\beta}) \tag{1}$$

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Where: $F(r)$ —trip distribution proportion for rural population, r —trip distance, α 、β —parameters.

If β immovably, α value decreases, the increasing extent of distribution proportion will be larger adapt to the increase of trip distance.so if have same trip distance and α value decreases,the distribution proportion of the trip distance will be greater. And if α immovably, β value increases, the increasing extent of distribution proportion will be larger adapt to the increase of trip distance.so if have same trip distance and β value increases,the distribution proportion of the trip distance will be greater.

The values of α and β affect the distribution of trip distance directly,so if get the the values of α and β according to reality of the region,the distribution of trip distance for rural population can be obtained.However, the values of α and β are associated with many factors, need to conduct qualitative analysis based on reality of the region,then use relevant mathematical methods to obtain the values or formulas of α and β.

3 Factors Analysis of Model Parameters

There are many factors can influence the trip distance of rural population,as regional geological structures, transportation condition and so on.The factors of parameters for trip distance distribution model can clear based on the characteristic of rural population trip and the actual situation in rural area.

A. Region Area

The distributions are unlikeliness in city and country in different region areas,and the range of activity is unlikeliness too,that is the trip distance will change.The positions of city and country are very dispersible in large region area,and could appear a small area whose center is a larger county or township, the rural population will move in this area around centrally,so the less communion in the neighboring area. The positions of city and country are very centralized in small region area,the rural pouplation can choose many cities and villages as the destination when they go outside,and the difference is less in trip time and cost,so can choose farther but more functionality city to satisfy the requirement,that is trip distance often farther.

B. Distribution Density of Village

The distribution density of village is the ratio of the numbers to acreage for village in same area,that is the average number of villages per square kilometer,it can show the denseness degree of village in the area.The distribution of trip distance is unlikeliness in different area which has denseness degree of village,the trip distance is short in the high density area,and the average trip distance is long in the low density area.

C. Transportation Condition

Transportation condition is the basic condition when people travel,and has a obvious influence to activity of people. The factors as degree of perfection for transport facility, travel convenience or not, travel economic and security can influence the trip

decision-making directly. Road network density, line extension, transport capacity structure, distribution of passenger stations make a huge difference to the travel convenience,and have a consanguineous relation of trip distance for rural population.

In addition to the above obvious factors, other factors can influence the parameters of trip distance distribution mode as trip purpose, population density, policy and so on.

4 Regression Analysis of Factors for Model Parameters

Combination of the above factors, the paper selected regional area, distribution density of village, sharing rate of passenger transport, the rural population as a regression variable. Combined with previous research results,to do regression analysis of the parameters based on the specific situation of the trip dataes and rural areas in Shaanxi Province. Table 1 shows the parameters of distribution function and related factors in different regions of Shaanxi Province.

Table 1. The values of parameters and factors in different regions of Shaanxi Province

	α	β	Region area(km^2)	Distribution density of village(per km^2)	Sharing rate of passenger transport(%)	Rural population
Xian	-0.30362	0.65846	9983	0.316638	36.21	4109657
Weinan	-0.28472	0.65769	13134	0.246307	32.64	3936237
Tongchuan	-0.14459	0.74061	3882	0.139876	41.08	447697
Xianyang	-0.2387	0.81125	10213	0.276412	30.81	3951228
Yulin	-0.40944	0.53535	43578	0.12644	40.43	2820383
Yanan	-0.34417	0.60415	36712	0.092368	42.56	1591272
Hanzhong	-0.17485	1.01733	27246	0.104272	41.62	3048381
Ankang	-0.19598	0.85215	23391	0.104827	47.04	2523441
Shangluo	-0.18657	1.00321	19292	0.091696	47.63	2066630

A. Regression Analysis of α

Regression analysis was done toward influence factors in different regions for, then selected the multiple linear regression and given the significance level of 0.05, the regression results of α as Table 2.

Table 2. Model Results

R	R square	F	Adjusted R Square	Std.Error of the Estimate	Change Statistics				
					R square Change	F Change	df1	df2	Sig F Change
0.997	0.993	148.649	0.987	185600.726	0.993	148.649	4	4	0.000

From the model results,the correlation coefficient is 0.997,and the coefficient of determination is 0.993,and the value of F is 148.649.which shows that region area, distribution density of village, sharing rate of passenger transport and rural population has a linear relationship with α .and the values of variables for regression equation as Table 3.

Table 3. Values of variables for Regression equation

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std.Error	Beta		
(Constant)	0.283	0.039		7.254	0.002
Region area	-9.9×10^{-6}	0.000	-1.485	-22.984	0.004
Distribution density of village	-1.908	0.120	-1.908	-15.861	0.000
Sharing rate of passenger transport	-0.503	0.084	-0.371	-6.018	0.001
Rural population	7.06×10^{-8}	0.000	0.979	9.881	0.000

So the Multiple linear regression equation as follow:

$$Y = 0.283 - 9.9\times10^{-6}X_1 - 1.908X_2 - 0.503X_3 + 7.06\times10^{-8}X_4 \quad (2)$$

Where: Y—the value of α ; X_1—region area(km2) ; X_2—distribution density of village(per km2) ; X_3—sharing rate of passenger transport(%) ; X_4—rural population.

The equation parameters must be tested to confirm the correctness of the model.

1)T-test: As the Table 3 show :

$t_1 = 7.254$, $t_2 = -22.984$, $t_3 = -15.861$, $t_4 = -6.018$, $t_5 = 9.881$;

From the bilateral critical value table of t distribution when the significance level is 0.05 could obtain:

$t_\alpha(n-p-1) = t_{0.05}(4) = 2.776$; and $|t_1| = 7.254 > t_{0.05}(4) = 2.776$; $|t_2| = 22.984 > t_{0.05}(4) = 2.776$; $|t_3| = 15.861 > t_{0.05}(4) = 2.776$; $|t_4| = 6.018 > t_{0.05}(4) = 2.776$; $|t_5| = 9.881 > t_{0.05}(4) = 2.776$.

So the four regression coefficients of X_1,X_2,X_3 and X_4 are significant in statistics.

2)F-tes:t As the Table 2 show : $F = 148.649$.

From the critical value table of F-test when the significance level is 0.05 could obtain: $F_\alpha(p, n-p-1) = F_{0.05}(4,4) = 6.39$.

And $F = 148.649 > F_{0.05}(4,4) = 6.39$, and the model is significant in statistics.

To sum up, the Multiple linear regression equation of α is effectively.

B. Regression Analysis of β

Use the same method, can obtain the multiple linear regression equation of β as follow:

$$Y = 1.267 - 1.6\times10^{-5}X_1 - 3.745X_2 + 1.70\times10^{-7}X_3 \quad (3)$$

Where: Y—the value of β ; X_1—region area(km2) ; X_2—distribution density of village(per km2) ; X_3—rural population.

5 Empirical Analysis

To validate the generality and the validity of the equations for α and β, compared the survey results with model results of trip distance distribution for rural population in Baoji City Shaanxi Province, the dataes of influence factors for trip distance distribution in Baoji as Table 4.

Table 4. The dataes of influence factors for trip distance distribution in Baoji City

	Region area(km^2)	Distribution density of village(per km^2)	Sharing rate of passenger transport	Rural population
Numerical value	18172	0.099164	48.61%	2805367

Input the the above dataes to equation (2) and (3),can obtain the values of α and β are -0.132557 and 1.081791 respectively.Then input the values of α and β to equation (1),so the trip distance distribution model for rural population in Baoji City as follow:

$$F(r) = 1 - \exp(-0.132557 r^{1.081791})$$

According to this model to calculate the trip distance distribution for rural population in Baoji City as Table 5.

Table 5. The trip distance distribution for rural population in Baoji City

Trip distance(km)	Trip distance distribution	Trip distance(km)	Trip distance distribution
⩽1	0.124147	⩽14	0.900031
⩽2	0.244653	⩽15	0.91637
⩽3	0.352774	⩽16	0.930106
⩽4	0.447825	⩽17	0.94164
⩽5	0.560476	⩽18	0.951313
⩽6	0.621829	⩽19	0.959417
⩽7	0.693105	⩽20	0.966198
⩽8	0.725512	⩽25	0.986594
⩽9	0.760185	⩽30	0.994764
⩽10	0.798158	⩽35	0.997981
⩽11	0.83036	⩽40	0.99923
⩽12	0.857609	⩽45	0.99971
⩽13	0.880624	⩽50	0.999891

According to actual statistics dataes of rural trip survey, the absolute error between survey results and model results as Table 6.

Table 6. The Error between survey results and model results of trip distance distribution

Trip distance(km)	The trip distance distribution			Trip distance(km)	The trip distance distribution		
	Survey results	model results	absolute error		Survey results	model results	absolute error
⩽1	0.170315	0.124147	0.046168	⩽14	0.896222	0.900031	-0.00381
⩽2	0.292891	0.244653	0.048238	⩽15	0.931965	0.91637	0.015595
⩽3	0.371668	0.352774	0.018894	⩽16	0.942485	0.930106	0.012379
⩽4	0.489789	0.447825	0.041964	⩽17	0.951094	0.94164	0.009454
⩽5	0.597571	0.560476	0.037095	⩽18	0.960341	0.951313	0.009028
⩽6	0.658625	0.621829	0.036796	⩽19	0.968075	0.959417	0.008658
⩽7	0.736087	0.693105	0.042982	⩽20	0.976643	0.966198	0.010445
⩽8	0.771229	0.725512	0.045717	⩽25	0.979504	0.986594	-0.007090
⩽9	0.779518	0.760185	0.019333	⩽30	0.984174	0.994764	-0.010590
⩽10	0.787129	0.798158	-0.011029	⩽35	0.986964	0.997981	-0.011017
⩽11	0.794342	0.83036	-0.036018	⩽40	0.990195	0.99923	-0.009035
⩽12	0.843666	0.857609	-0.013943	⩽45	0.993647	0.99971	-0.006063
⩽13	0.878809	0.880624	-0.001815	⩽50	0.996476	0.999891	-0.003415

From Table 6, the absolute error between survey results and model results is less, and the maximum is only 0.048, namely 4.8%, less than 5%.so the influence factors of model has high rationality and the model has high accuracy.

6 Conclusion

The trip distance of rural population is influenced by trip purpose, region area, transportation condition and so on.The rural area should modify the parameters based on its characteristic when use the model,and obtain the trip distance distribution model which adapt to itself.

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Double Fuzzy-PID Controller Design for EPS AC Asynchronous Motors*

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Abstract. To seek a more reasonable control strategy for asynchronous motors is the difficulty and focus in the development of automobile EPS. A stability design approach for T-S fuzzy model based AC asynchronous motors is proposed and double fuzzy-PID controllers are designed in this paper. The closed-loop pole locations are chosen and the state-feedback controllers in different certain states are designed. On combining the rules in the fuzzy model and the fuzzy logic, two fuzzy sub-controllers are formed. Also a PID controller is designed to ensure output to converge to a given value. An illustrative example demonstrates that the double fuzzy-PID controller has good robustness, rapidity and stability, and can ensures the motor output to converge to a given torque value.

Keywords: Double Fuzzy-PID Controller, AC Asynchronous Motor, T-S Model, EPS.

1 Introduction

In recent years, electric power steering (EPS) for vehicles is becoming a popular tendency in modern car. Consequently some study and design in EPS for heavy duty trucks and coaches are more highly focused now. Generally, the mainly difficulty is to choose adaptive motor for EPS. Compare with the same volume DC motors, AC asynchronous motors are easy to work with higher power factor and can provide high torque, which are more suitable for large and middle vehicles. Thanks to some advantages such as maintenance-free and small volume, AC asynchronous motors are introduced and come into use for EPS [1]. However AC asynchronous motors belong to highly nonlinear and strong coupling system, their control technologies have been difficult problems and focus for researches. Nowadays vector control and direct torque control are two more mature control theories and methods used for AC asynchronous motor control. Because these two methods are much more complicated and are implemented by means of more electric power system [2], they are difficult when directly used to EPS. In order to control EPS with AC asynchronous motors

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better and to promote research and development of EPS, it is necessary to seek a more reasonable control strategy. In this paper, a control strategy for highly nonlinear and strong coupling system is proposed and double fuzzy-PID controller for AC asynchronous motor is designed.

2 The Mathematical Model of AC Asynchronous

According to the mathematical model of two-phase asynchronous motor with rotor flux orientation in rotating coordinate system, we model the plant as a two-input, one-output, and three-state minimum phase system. A state-space model for the system is given by

$$\begin{bmatrix} u_{sM} \\ u_{sT} \\ 0 \end{bmatrix} = \begin{bmatrix} R_s + \frac{L_m^2}{T_r L_r} & -\omega_1 \sigma L_s & -\frac{L_m}{T_r L_r} \\ \omega_1 \sigma L_s & R_s & \omega_1 \frac{L_m}{L_r} \\ -\frac{L_m}{T_r} & 0 & \frac{1}{T_r} \end{bmatrix} \begin{bmatrix} i_{sM} \\ i_{sT} \\ \psi_r \end{bmatrix} + \begin{bmatrix} \sigma L_s & 0 & 0 \\ 0 & \sigma L_s & 0 \\ 0 & 0 & 1 \end{bmatrix} \frac{d}{dt} \begin{bmatrix} i_{sM} \\ i_{sT} \\ \psi_r \end{bmatrix} \tag{1}$$

In (1), we define our state variable as $\mathbf{i} = [i_{sM} \quad i_{sT} \quad \psi_r]^T$ and define our control input as $\mathbf{u} = [u_{sM} \quad u_{sT} \quad 0]^T$. Then state equations of AC asynchronous are given as follows:

$$\frac{d}{dt}\mathbf{i} = \mathbf{A}\mathbf{i} + \mathbf{B}\mathbf{u} \tag{2}$$

$$y = T_e = \mathbf{C}\mathbf{i} \tag{3}$$

where,

$$\mathbf{A} = \mathbf{E}^{-1} \begin{bmatrix} R_s + \frac{L_m^2}{T_r L_r} & -\omega_1 \sigma L_s & -\frac{L_m}{T_r L_r} \\ \omega_1 \sigma L_s & R_s & \omega_1 \frac{L_m}{L_r} \\ -\frac{L_m}{T_r} & 0 & \frac{1}{T_r} \end{bmatrix} \qquad \mathbf{B} = \mathbf{E}^{-1} \begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \end{bmatrix},$$

$$\mathbf{C} = n_p \frac{L_m}{L_r} i_{sT} [0 \quad 0 \quad 1]$$

$$\mathbf{E} = \begin{bmatrix} -\sigma L_s & 0 & 0 \\ 0 & -\sigma L_s & 0 \\ 0 & 0 & -1 \end{bmatrix}, \mathbf{E}^{-1} = \begin{bmatrix} -\frac{1}{\sigma L_s} & 0 & 0 \\ 0 & -\frac{1}{\sigma L_s} & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

Where u_{sM} ,u_{sT} and i_{sM} ,i_{sT} and ψ_{sM} ,ψ_{sT} are the component of voltage, current and flux of stator and rotor in the direction of M and T axis respectively; L_s and L_r are self-inductance of stator and rotor respectively; L_m is mutual inductance between stator and rotor; R_s and R_r are resistance of stator and rotor respectively; ω_1 is the synchronous frequency of motor; p denote differential operator; n_p is number of pole pairs; T_e is electromagnetic torque.

Also,

$$T_r = \frac{L_r}{R_r} \tag{4}$$

$$\sigma = 1 - \frac{L_m^2}{L_s L_r} \tag{5}$$

The synchronous frequency ω_1 is determined by the transmission ratio between speed of steering wheel and reduction gears mechanism of EPS. The relation between ω_1, rotor velocity ω_r and loading of motor T_L can be expressed as:

$$\omega_1 = \frac{\omega_r}{s} \tag{6}$$

$$T_e = T_L + \frac{J}{n_p}\frac{d\omega_r}{dt} \tag{7}$$

Where J is moment of inertia of rotor; s is slip ration of motor, which is between 0.01 and 0.05 usually[2].

3 Double Fuzzy-PID Controller Design

A. Design of fuzzy Controller Based on CDF

In each kind certain state, dynamic compensators for motor system can be designed using pole placement techniques[3]. The corresponding control architecture is shown in Figure 1.

Where $\mathbf{K}$ is an appropriate gain matrix, and $\mathbf{F}$ is the gain matrix of the input. In order to make the motor output y to converge to a given torque value r^* the state-feedback controller should be:

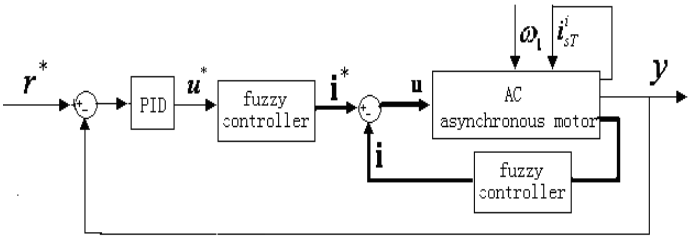


Fig. 1. The diagram of double fuzzy-PID controller and system

$$\mathbf{u} = -\mathbf{K}\mathbf{i} + \mathbf{i}^* = -\mathbf{K}\mathbf{i} + \mathbf{F}r^* \tag{8}$$

Here system states can estimate by designing a state estimator (or observer) of the form:

$$\frac{d}{dt}\mathbf{i} = \mathbf{A}\mathbf{i} + \mathbf{B}\mathbf{u} + \mathbf{F}(y - \mathbf{C}\mathbf{i} - \mathbf{D}\mathbf{u}) \tag{9}$$

For illustration purposes, we allow the value ω_1 and i_{sT} to vary between the max and the min value. Here, the takagi-sugeno (T-S) fuzzy models [4]and controller model have the follows form:

R^i: if ω_1 is ω_1^i, and i_{sT} is i_{sT}^i

Then $\frac{d}{dt}\mathbf{i} = \mathbf{A}_i\mathbf{i} + \mathbf{B}\mathbf{u}$, $\quad y = T_e = \mathbf{C}_i i$,

$$\mathbf{u} = -\mathbf{K}_i(\mathbf{i} - \mathbf{i}^*) = -\mathbf{K}_i\mathbf{i} + \mathbf{F}_i r^* \quad (i = 1,2,\ldots,l) \tag{10}$$

Using single point fuzzy sets as fuzzy models, and weighted average method as defuzzification methods, the state equation of motors system and controller, which stability has be proved in references [5], can be modified, may be expressed as follows:

$$\frac{d}{dt}\mathbf{i} = \sum_{i=1}^{l} h^i(\mathbf{A}_i\mathbf{i} + \mathbf{B}\mathbf{u}), \qquad y = T_e = \sum_{i=1}^{l} h^i\mathbf{C}_i i$$

$$\mathbf{u} = \sum_{i=1}^{l} h^i(-\mathbf{K}_i\mathbf{i} + \mathbf{i}^*) = -\sum_{i=1}^{l} h^i\mathbf{K}_i\mathbf{i} + \sum_{i=1}^{l} h^i\mathbf{F}_i r^* \tag{11}$$

$$\text{Where } h^i = \mu^i(\omega_1, i_{sT}) / \sum \mu^i(\omega_1, i_{sT}) \tag{12}$$

$\mu^i(\omega_1, i_{sT})$ denotes membership function of (ω_1, i_{sT}) belonging to the i th rule.

B. Design of PID Controller of the total system

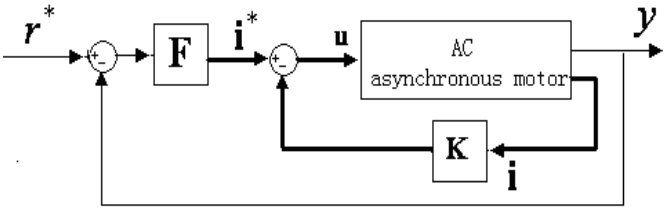


Fig. 1. The diagram of state feedback control system

To ensure that the total system has good static-dynamic performance, we should design a PID controller to auxiliary control [6]. The PID controller term is

$$u^* = K_P e(t) + K_c \int_0^t e(\tau) d\tau + K_d \frac{de(t)}{dt} \tag{13}$$

Where $e(t)$ is the error between the reference r^* and feedback inputs y, and K_P is the proportional gain, K_c is the integral correction gain, and K_d is the derivative gain of the PID controller. The total system model, shown in the following figure 2, contains the two-phase AC asynchronous motor plant and a simple PID controller, and a fuzzy controller, in a single-loop feedback system.

4 Examples

To evaluate design method of the fuzzy-PID controller, an AC asynchronous motor is chosen and controller is designed. The motor is rated three phase, 5.5kw, 13A, 50 Hz, 2 poles and 35N-m base torque. Under the rated conditions the operation range of ω_1 and i_{sT} are -60π - 60π and -19A-19A respectively. The other main datum of the motor are defined in Table 1.

Table 1. Main Datum of the Motor

$J = 0.032\text{kgm}^2$	$L_m = 0.035\text{H}$
$L_s = 6.02\times10^{-4}\text{H}$	$L_r = 6.02\times10^{-4}\text{H}$
$R_s = 0.07\Omega$	$R_r = 0.13\Omega$

The motor's T-S fuzzy models have the follows form:

R^1: if ω_1 is -60π, and i_{sT} is -19A

Then $\frac{d}{dt}\mathbf{i} = \mathbf{A}_1\mathbf{i} + \mathbf{B}\mathbf{u}$, $y = T_e = \mathbf{C}_1 i$

R^2: if ω_1 is -60π, and i_{sT} is 19A

Then $\frac{d}{dt}\mathbf{i} = \mathbf{A}_2\mathbf{i} + \mathbf{B}\mathbf{u}$, $y = T_e = \mathbf{C}_2 i$

R^3: if ω_1 is 60π, and i_{sT} is -19A

Then $\frac{d}{dt}\mathbf{i} = \mathbf{A}_3\mathbf{i} + \mathbf{B}\mathbf{u}$, $y = T_e = \mathbf{C}_3 i$

R^4: if ω_1 is 60π, and i_{sT} is 19A

Then $\frac{d}{dt}\mathbf{i} = \mathbf{A}_4\mathbf{i} + \mathbf{B}\mathbf{u}$, $y = T_e = \mathbf{C}_4 i$

Here, the membership functions[7] of ω_1 and i_{sT} are shown in Fig. 3 and Fig. 4.

$$\text{Where, } \mathbf{A}_1 = \mathbf{A}_2 = \begin{bmatrix} 216 & -185 & -6172 \\ 185 & 0.03 & -5297 \\ 7.5 & 0 & -216 \end{bmatrix},$$

$$\mathbf{A}_3 = \mathbf{A}_4 = \begin{bmatrix} 66 & 216 & 66 \\ 0.03 & -66 & 0.03 \\ 0 & 7.5 & 0 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} -0.49 & 0 & 0 \\ & -0.49 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\mathbf{C}_1 = \mathbf{C}_3 = [0 \quad 0 \quad -2209]', \mathbf{C}_2 = \mathbf{C}_4 = [0 \quad 0 \quad 2442]$$

In this approach the weights are design controller parameters and pole placement, and the following variables are either optimized or constrained:

1) Steady state error is lower than 1%, and dynamic error is lower than 5%;
2) The max overshoot of the unit step response is lower than 5%;
3) The settling time of the unit step response is lower than 0.1s;
4) The rise time of the unit step response is lower than 0.05s;

Placing the closed-loop poles at

$$p = [-20 + 2i \quad -20 - 2i \quad -80],$$

the state feedback gain matrices needed and input gain matrices and some parameters of PID controller return the following results:

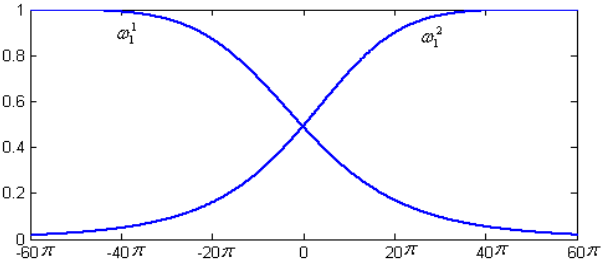
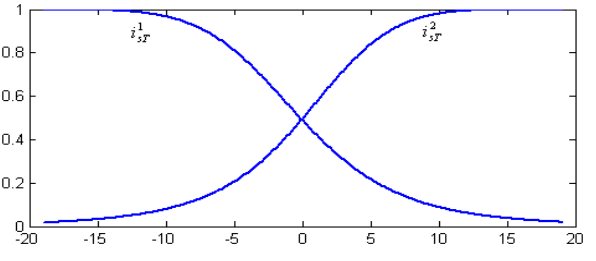


Fig. 3. The membership function of ω_1



F

Fig. 4. The membership function of i_{sT}

$$\mathbf{K}_1 = \mathbf{K}_2 = \begin{bmatrix} -82 & 378 & 2141 \\ -378 & -163 & 10810 \\ 0 & 0 & 0 \end{bmatrix}, \mathbf{K}_3 = \mathbf{K}_4 = \begin{bmatrix} -82 & 378 & 2141 \\ -378 & -163 & 10810 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\mathbf{F}_1 = [-649 \quad 37.7 \quad 1], \mathbf{F}_2 = [-618 \quad 165 \quad 1]$$

$$K_d = 0.0125, K_c = 0.816, K_P = -0.0385$$

The step response of the closed-loop system is shown in Fig. 5, in which the response matches exactly with the requirement of system design. Fig.6 illustrates the torque errors between electromagnetic torques of the motor and external load are close to zero under low frequency external load, and the motor output can converge to a given torque value precisely. Figure 7 shows the max torque errors are less than 2% under high frequency abrupt load and can incline to zero rapidly within at short time. All these simulated curve show that the system and controller response is faster and accurate. The design controllers are feasible and the control effect is good.

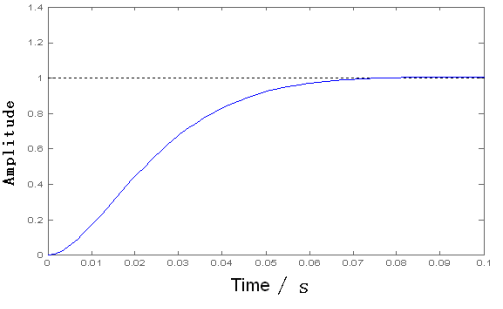


Fig. 5. The step response of the closed-loop system

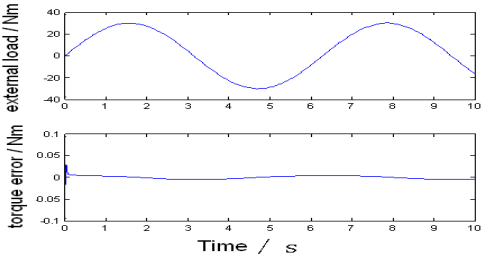


Fig. 6. Torque errors under low frequency external load

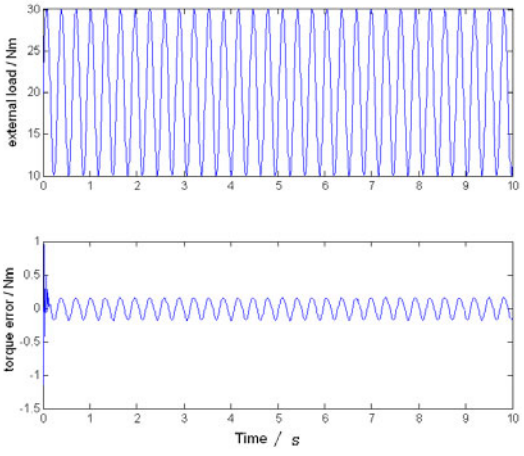


Fig. 7. Torque errors under high frequency external load

5 Conclusion

A stability design approach for T-S fuzzy model based AC asynchronous motors is proposed and double fuzzy-PID controllers are designed in this paper. The closed-loop response of the stronger nonlinear system behaves like a linear system. Following the closed-loop pole locations chosen, two fuzzy controllers based on CDF are designed and system performance in disturbance attenuation can be achieved as desired. Also the designed PID controller ensures the motor output to converge to a given torque value. All the results of the example demonstrate the designed the double fuzzy-PID controller has good robustness, rapidity and stability, and can ensures the motor output to converge to a given torque value.

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Traffic Distribution Model of Freight Service Network Based on Integrated Transport System

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Abstract. Although there are lots of literatures about flow traffic distribution, but the most of them focus on the idea of single transport mode and shortest path transportation. That idea no longer meets the current transport situation, we need consider more transport mode and more paths to be prepared for selected. Based on new idea, This paper then establishes new mathematical model, the objective function minimizes transit and transportation cost, constraints considers both capacity configuration and different transport mode. Then this paper proposes a new path search algorithm to solve the model based on integrated transport system. The algorithm combined with Lingo11 can solve the mathematical model, Example shows the effectiveness of the solution. The work of this paper provides a better solution to solve freight trffic distribution based on integrated transportation system.

Keywords: Integrated transportation System, Freight trffic distribution, Path search algorithm.

1 Introduction

Traffic flow distribution is one classic field of the transport and transportation. Its major research aims are to determine the traffic amount in specific arcs of network under the giving certain level of supply and demand conditions, and to simulate the current state of the entire transportation network to assess its performance, these works can provide basis suggestions to policy makers and network development plan makers[1]. Lansdowne study the, rail freight network assignment under multi-operator case [2]; Clarke also study railway network traffic distribution under the condition of multi-operator case, the main purpose of his research is to calculate the rail network system capacity[3]; Jian-Yong Zhang, etc establish a model of transport for the optimal goal of mode selection and minimize of transport cost, the model also considers multimodal organizational on the basis of previous studies, but the paper does not give the solution algorithm for the model. Literature [1] and [4] study algorithms using the method of "node splitting approach" under integrated transport system, this method can be used for physical network, but is not proper for service network because there are always much more transit cases in service network, using node splitting approach will make the scale of problem too large. Besides, most of research literatures focus on the optimization of transit cost between different transport modes, but we need to consider

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optimizing the transit cost between different services in service network. Based on this, this paper presents a more reasonable freight flow distribution model in the service network under the integrated transport system. and propose a solution algorithm based on "T label" and "S label" approach, and then build dynamic lingo script using c# and lingo develop interface for. NET platform to solve the model. The example verifies the effectiveness of the algorithm. this solving way can make some suggestions for area of the service network design.

2 Math Model

Let *N* represents the set of nodes, *n* means the *n*-th node in N. *A* represents the set of arcs, α means the α-th arc in *A*. *M* represents all transport modes in integrated transport system, and m means the *m*-th transport mode in *M*. *L* represents the set of service level. *O* represents the set of OD, and *d* means the *d*-th OD in *O*, we call cargo flow *d* for short. O_d means the amount of cargo flow *d*. K represents the number of KSP(*k*-shortest path), P^d means the set of transport path for cargo flow d, P_k^d means the k-th path in P^d. $\beta_{k,\alpha}^d$ means whether arc α is contained in transport path P_k^d, if contained, then $\beta_{k,\alpha}^d = 1$, else $\beta_{k,\alpha}^d = 0$. $Len(d,k)$ means the number of roads in path P_k^d.

$\delta_{k,n}^d$ means whether node *n* is the start node of transport path for cargo flow *d*, if that is then $\delta_{k,n}^d = 1$, else $\delta_{k,n}^d = 0$. $\phi_{k,n}^d$ means whether node *n* is contained in transport path P_k^d (except the start node and end node of path P_k^d). If contained then $\phi_{k,n}^d = 1$, else $\phi_{k,n}^d = 0$. $\sigma_{k,n}^d$ means whether node *n* is the end node of transport path for cargo flow *d*, if that is then $\sigma_{k,n}^d = 1$, else $\sigma_{k,n}^d = 0$.

$\beta_{d,k,i}^m$ means whether the *i*-th service arc in path P_k^d belongs to transport mode *m*, if that belongs then $\beta_{d,k,i}^m = 1$, else $\beta_{d,k,i}^m = 0$. $index(d,k,n)$ means the position(index number) of node *n* in path P_k^d, if node *n* is not contained in path P_k^d, then $index(d,k,n) = 0$.

c_α^d represents the unit transport cost of cargo flow d transported in service arc α. $\Gamma_{k,n}^d$ means the unit transit cost in node n. S_n^m means the deliver capacity of transport mode m in node n, R_n^m means the receive capacity of transport mode m in node n, T_n^m means the transit capacity of transport mode m in node n. u_α means the throughout capacity of arc α, t_α^d means the transport time of cargo flow d in arc α,

t_k^d means the transport time of cargo flow d in path P_k^d. l_d means the required service level for cargo flow d, this paper uses the transport deadline time to represent the service level.

$\psi_{k,n}^d$ means whether the transit case is existing in node n for cargo flow d, if existing then $\psi_{k,n}^d = 1$, else $\psi_{k,n}^d = 0$. If $n \notin P_k^d$, then $\psi_{k,n}^d = 0$.

Decision variant x_k^d means the flow amount of cargo flow d in transport path P_k^d ($k \le K$). The math model is showed as follow.

The objective function:

$$\text{Min}\, \omega_1 \sum_{d\in D}\sum_{k=1}^{K}\sum_{\alpha\in A} \beta_{k,\alpha}^d x_k^d c_\alpha^d + \omega_2 \sum_{d\in D}\sum_{k=1}^{K}\sum_{n\in N} \phi_{k,n}^d x_k^d \Gamma_{k,n}^d \tag{1}$$

S.T.:

$$\sum_k x_k^d = O_d \tag{2}$$

$$\sum_{d\varepsilon D}\sum_k \beta_{k,\alpha}^d x_k^d \le u_\alpha, \quad \forall \alpha \tag{3}$$

$$t_k^d \le l_d \tag{4}$$

$$t_k^d = \sum_\alpha \beta_{k,\alpha}^d t_\alpha^d \tag{5}$$

$$\sum_{d\varepsilon D}\sum_{k=1}^{K} \delta_{k,n}^d \beta_{d,k,1}^m x_k^d \le S_n^m, \quad \forall n \tag{6}$$

$$\sum_{d\varepsilon D}\sum_{k=1}^{K} \phi_{k,n}^d \psi_{k,n}^d \beta_{d,k,index(d,k,n)}^m x_k^d \le T_n^m, \quad \forall n \tag{7}$$

$$\sum_{d\varepsilon D}\sum_{k=1}^{K} \sigma_{k,n}^d \beta_{d,k,Len(d,k)}^m x_k^d \le R_n^m, \quad \forall n \tag{8}$$

The object function means minimizing the total transport cost and transit cost of all cargo flow d as possible as we can. ω_1 and ω_2 are two weight coefficients and $\omega_1 + \omega_2 = 1$. Constraint (2) means the cargo flow amount constraint. Constraint (3) means the road throughout capacity constraint. Constraint (4) means the service level constraint. Constraint (5) means the formula of transport time in transport path. Constraint (6) means the deliver capacity of node. Constraint (7) means the transit capacity of node. Constraints (8) means the receive capacity of node.

3 Solving Algorithm

In the past, most of research literatures for flow distribution focused on the shortest path mechanism, but with the rapid development of freight transport, using the shortest path mechanism to solve the flow distribution can't meet the transportation needs. Based on this, Ministry of Railways proposed the diversion strategy of "one main, two wings, two lines and three districts". Based on this idea, this paper taking into account the realities and the large-scale problem, divides the problem of flow distribution under the integrated transport system into two-step: first, determined the set of transportation path (using KSP mechanism); second, based on the given set of paths, optimizing the flow distribution.

3.1 The Realization on Determined *K*-Shortest Paths

This paper improves the deviation path search algorithm to solve the KSP under integrated transport system. In that algorithm, we also need improve the shortest path algorithm. The improved KSP algorithm and shortest algorithm will be introduced in detail below. In order to use the algorithms properly, we should label the transfer weight on the nodes(we call this process "T label"), and the label form is (predecessor node, predecessor arc, successor arc, successor node, transfer weight). Fig.1 expresses the integrated transportation network after T label. Shortest path search algorithm also requires using the label information (we call this process "S label"), and its forms is (predecessor arc, the current minimum distance, whether transfer, transfer times). Besides label information, the algorithm of K shortest path solves the circuit by adding the taboo information on the nodes, the taboo form is (starting node of path, predecessor arc, successor arc). It needs to determine whether the successor arc of current node is tabooed. And if it is tabooed, it should not update the S label's information of successor node by successor arc.

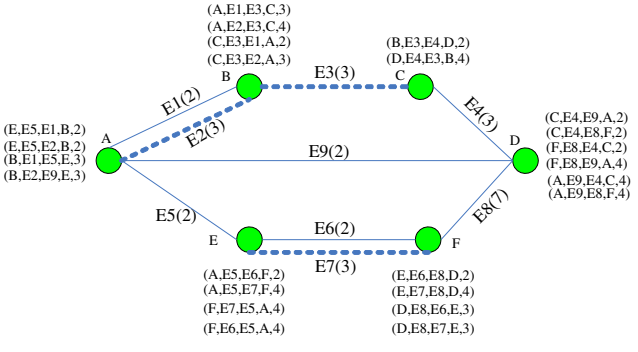

Fig. 1. T label of integrated transport network

First, we establishes two sets: C and O. C is used to save the traversed nodes and O is used to save the nodes which were not traversed. The ideas of the improved shortest algorithm is shown as follows:

Step1. Setting the starting node *s* in set C.

Step2. Traversing the non-taboo adjacent arcs composed by all adjacent nodes of the starting node s in set O (we can call this kind of arc as "non-taboo adjacent arc" in set O). Set S label information of terminal node *u* of the adjacent arc which has the minimum adjacent weight. Because we have to deal with to the interference of transfer weight here. After setting S label information to node *u*, traversing all non-taboo adjacent arcs of the u in set O, and setting S label information to the follow-up node which is the same type as preorder arc on the node *u* (in the S label information). Then continued to traverse follow-up nodes, and repeating this labeling process until the arc of the same type does not exist. Setting the node *u* in set C. This procedure is called pre-search.

Step3. Traversing the non-taboo adjacent arcs of the node *u* in set O, and selecting the adjacent arc which has the minimum weight that arc throughout weight plus the transfer weight. Then set S label information to the terminal node *f* of the adjacent arc, and set the node *f* in the set C. Because of interference factor of the transfer weight here. The procedure of pre-search on traversing follow-up nodes of node *f* is operated just as described in Step2.

Step4. Updating the information of node *u* to the node *f*. Then determine whether set O is empty. If the set O is empty, the algorithm will stop. Otherwise, turn to Step3.

The idea of K short is as follows:

Step 1. Determine the starting node *s* and terminal node *t*. Then setting all nodes in the set O, and emptying the taboo information of all nodes and the candidate path set H.

Step 2. Using the shortest path algorithm mentioned above to find the shortest path P between the node *s* and the node *t*, and adding taboo information to all nodes except the terminal node on the path P.

Step 3. To traverse each node in the path P from the terminal node. If the out-degree of the node is greater than 1, setting all nodes form the starting node to this node in the set C (avoiding circuit). Using the shortest path algorithm mentioned above to search the shortest path from this node to the terminal node, and combined the shortest path from the starting node to this node to compose the candidate shortest path, then adding to the candidate path set H.

Step 4. If the set H is not empty, selecting the path which has the minimum weight in the set H as the k short-circuit, and *k* plus 1. Determine whether *k* equals to K. If *k* equals K, the searching process ends. If *k* is less than K, it should determine whether the set H is empty. If H is empty, it means that there are only *k* shortest paths. Then it should turn to Step1 to continue to the next path search. Otherwise, making the P set to U, and turn to Step3.

3.2 Assignment Algorithm Realization

The model presented in this paper is a linear optimization model; it can be solved by Lingo. However, due to the relationship among the node, the arc and the path, the model is very complicated, which leads to high complexity of data processing in Lingo, at the same time, Lingo is lack of visually creating script, based on this, this paper using the combination of C# language of the VS2005 and optimization engine of Lingo11 (Lingo11 provide develop interface for C++, Java and C#) develops the freight network flow distribution system,

which visually creating point, line to realize the construction of network topology, then on the basis of the input parameters, dynamic create the Lingo script, avoid the complexity of the mere use of Lingo scripting. At the same time increase the practical applicability of the Lingo algorithmic. Realization ideas are as follows:

Step.1 C# provides graphical interface, structural network diagram visually, perform the L label process, then set up topological relation between the point and line.

Step.2 Input OD data and related coefficient, such as OD transport deadline, service level requirements, cost limit and so on. On the basis of network topology, using the shortest path or the *K* shortest path search algorithm mentioned above, get the OD transport path set; set service transit cost parameter on each point.

Step.3 Traversing the path of each OD, in the traversing process, we generate the constraint formula dynamically using the parameters we input before. All the constraint formula can be generated on corresponding node or arc or path.

Step.4 After establishing the script, we can solve the model in VS2005 environment, and get the result. So that we can generate lots of figures.

The system has got the software copyright, we have use the platform to evaluate lots of case. The next chapter, we will use one small case to test the algorithm.

4 Case

The network is shown as Fig.2. the numbers in bracket on arc means the throughout weight(up direction and down direction). OD requirement is shown as Table.1. we use transport deadline to represent the service level. For convenience, we set the transit cost parameters as follow: 5h between railway and road transport, 6h between road and airline transport, 7h between railway and airline transport. we set the receiving capacity, sending capacity and transit capacity equal to 500T. Set weight coefficient $\omega_1 = \omega_2 = 0.5$. The solving result is shown as Table2.

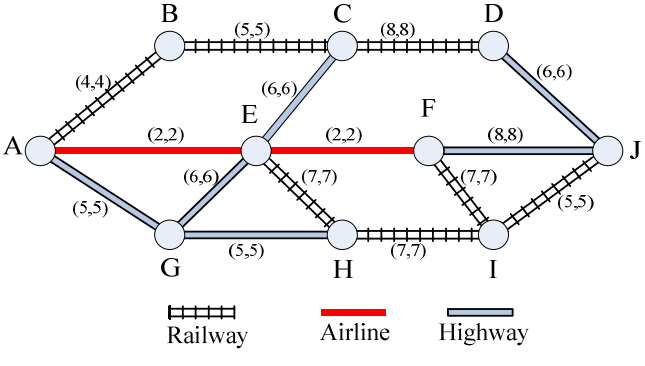

Fig. 2. Network for case

Table 1. OD Information

NO	O-D	Amount /T	Service level/h	NO	O-D	Amount /T	Service level/h
1	A-D	100	24	6	J-B	150	48
2	A-F	150	24	7	E-I	100	24
3	A-I	150	36	8	E-J	200	24
4	B-J	100	48	9	G-D	150	36
5	I-A	100	48	10	G-J	200	36

Table 2. Transport path for each OD and solving result

NO	O-D	Shortest path	Secondary shortest path
1	A-D	A-B-C-D (100)	A-E-C-D(0) (not meet service level)
2	A-F	A-E-F (150)	A-G-E-F (0)
3	A-I	A-E-F-I (50)	A-G-H-I (100)
4	B-J	B-C-D-J (100)	B-A-E-F-J (0)
5	I-A	I-F-E-A (100)	I-H-G-A (0)
6	J-B	J-D-C-B (150)	J-F-E-A-B (0)
7	E-I	E-H-I (100)	E-F-I (0)
8	E-J	E-F-J (0)	E-H-I-J (200)
9	G-D	G-E-C-D (150)	G-E-F-J-D (150)
10	G-J	G-H-I-J (200)	G-E-F-J (0)

In Table2, the number in bracket means the flow amount in the corresponding path. Just as Table2 shows, the solving algorithm considers the capacity constraints, the service level constraints and the *K*-shortest path mechanism.

5 Conclusion

This paper studies the optimization of freight flow distribution under integrated transport system. We first establish a new model which considers the optimization of transport cost and transit cost, besides, the constraints also considers the capacity configuration by transport mode. Then we propose the solving algorithm, including the shortest path and *K*-shortest path search algorithms. We also develop a system using c# and lingo11. the case verifies the algorithm.

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Off-Line Handwritten Chinese Signature Verification Based on Support Vector Machine Multiple Classifiers

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Abstract. Signature as a generally accepted way of consent and authorization plays an important role in social life. According features of off-line handwritten Chinese signature, utilized Support Vector Machine multiple classifiers which were constru-cted by extracting signature features combination method, and through decision module based on data fusion implemented off-line handwritten Chinese signature identification. Experiments show that the signature identification effect has been greatly im-proved.

Keywords: off-line handwritten signature, Support Vector Machine, classifier, signature verification.

1 Introduction

Signature as a generally accepted way of a consent or authorization, widely applied to financial, administrative, legal, security and so on, in social life plays an important role. According to the way of obtained data, handwritten signature verification can be divided into on-line and off-line signature verification. Off-line handwritten signature verification is done after the signature act, and the object of study is static image, not to obtain dynamic information, so it is very difficult to accurately identify off-line signature, and verification efficiency is lower than on-line signature.

As the writing features and the structure of Chinese is different from English, the Chinese off-line signature verification methods is quite different from English.The study of off-line Chinese signature verification, Cheng Xi and Hou Yibin[1] According to the signature features proposed 6 membership functions based on fuzzy pattern recognition; Jun Lin and Jiegu Li[2] proposed the method by extracting static features and high pressure features of signature constructed classifiers based on Euclid distance with Weights; ZHU Yong, TAN Tie-Niu et al[3] proposed using multi-channel two-dimensional Gabor filters to extract texture features of signature, and to complete the match work by structuring classifiers based on Euclid distance with weights; Chenglin Liu, Yingjian Liu et al[4] proposed the identification method based on multi-channel decomposition and matching; Hai Lin, Haizhou Li[5] proposed by extracting the Normalized Zernike Moment Invariants feature of signature, to complete the match work by structuring classifiers based on Euclid

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distance with weights; Ke Jing, Qiao Yizheng[6] proposed the method by extracting the static features and pseudo-dynamic features, Identified by calculating the distance.

In the paper, proposed constructing Support Vector machines (SVM) multiple classifiers parallel combination, through decision module based on data fusion to achieve off-line signature verification, and achieved a better identification results.

2 Support Vector Machine Classifier

SVM is based on the theory of VC dimension of statistical learning theory and structural risk minimization principle, and based on limited sample information between model complexity and learning ability find the best compromise in order to obtain the best generalization ability.

Assume that size α of the training sample set $\{(x_i, y_i), \quad i = 1,2,...,\alpha\}$ composed of two categories, If $x_i \in R^N$ belongs to Class 1, marked $(y_i = 1)$; If $x_i \in R^N$ belongs to Class 2, marked $(y_i = -1)$. Machine learning goal is to construct a discriminant function, correctly classified as test data.

For the linear separable training sample cases there will be a separating hyperplane:

$$xw + b = 0 \tag{1}$$

Makes the normalized range of linear separable sample set required:

$$y_i[(w * x_i) + b] \geq 1, \quad i = 1,2,...,\alpha \tag{2}$$

By the statistical learning theory, the optimal hyperplane means training set error is not separated hyperplane and the maximum distance between the hyperplane away from the most recent sample data and hyperplane, the resultant discriminant function:

$$f(x) = \mathrm{sgn}\{(w * x) + b\} \tag{3}$$

Where $\mathrm{sgn}(.)$ is a symbolic function, while classification interval equal to $2/\|w\|$, the maximum interval is equivalent to $\|w\|^2$ the minimum, the classification surface which to meet Equation (2) and the $\frac{1}{2}\|w\|^2$ smallest is called the optimal separating surface. Classification interval is actually the largest capacity on the control of the promotion, which is one of the core ideas of SVM.

Training sample set is linearly non-separable, Equation (2) need to introduce non-negative variables c, and then Equation (2) becomes:

$$y_i[(w * x_i) + b] + \xi_i \geq 1, \quad i = 1,2,...,\alpha \tag{4}$$

the target changes to find the smallest $(w,\xi)=\frac{1}{2}\|w\|^2+C\left[\sum_{i=1}^{\alpha}\xi_i\right]$, where C is a given value to control the degree of punishment sample misclassification, wh-ich considering minimum error classified sample and maximum classification intervals to the generalized optimal separating hyperplane, $Lagrange$ optimization method enables the op-timal separating hyperplane to be transformed to its dual pro-blem[7].

Training sample set is nonlinear, it can be the training sample set by linear transformation into a high dimensional space to a linear problem, constructed the optimal separating hyperplane in transform space, while in solving optimization problems and calculating discriminant function not need to calculate the nonlinear function, only calculating the kernel function. According to the theory of functional, as long as a nuclear function c satisfy the Mercer condition, it corresponds to a inner product of change space. Therefore, the optimal classification surface in the appropriate inner product kernel function c, can achieve a linear classification of non-linear transformation, while the computational complexity is not increased.

Different SVM kernel functions will form a different algorithm, usual kernel functions currently studied are:

Polynomial kernel function:

$$K(x_i,x_j)=[(x_i*x_j)+1]^q \tag{5}$$

Radial basis kernel function (RBF):

$$K(x_i,x_j)=\exp(-\gamma*\left|x_i-x_j\right|^2) \tag{6}$$

Multi-Layer Perceptron kernel function:

$$K(x_i,x_j)=\tanh(\nu(x_i*x_j)+c) \tag{7}$$

3 SVM Multiple Classifiers Combination and Data Fusion Decision

SVM Multiple classifiers combination there are two types of series and parallel[8], Series structure, classifiers in series, with the order, for the post before a classifier provides a classification of classified information, under the guidance of a classification process. The usual practice is for each classifier set a certain threshold, the sample input feature vector is greater than the threshold value, and the classifier can make decisions; and if less than the threshold value, the system automatically to the next a classifier, and use the next rule classifier re-pattern recognition. In the parallel structure, all classifiers are independent; the implementation of simultaneous detection, truly different complementarities between classifiers, the other in the detection time will be shorter than the series structure, thus improving detection speed.

The extracted features of Handwritten signature verification to try to reflect the individual style of writing and in order to identify the accuracy and efficiency of the extracted features should have stability and can be distinguished, independence, and less quantity. In this paper, Signature image of the effective aspect ratio, black spot area and total area ratio, horizontal and vertical signature frame relative center of gravity, mesh numbers and connected component numbers, contour direction vector tilt features, stroke density features to reflect the shape feature of the signature[1], and building on this basis SVM classifier 1; Extracted from the handwritten signature images using histogram features[6] Construction of SVM classifiers 2; Extraction of the signature features of the high-intensity[9] Construction of SVM classifier 3; Extraction of gray-scale features of the direction of the signature skeleton[10] Construction of SVM classifiers 4.

The results of each classifier into data fusion decision module, the module first output of classifier fuzzy, then a comprehensive evaluation, Identification results obtained.

Results of fuzzy classification by fuzzy sets instead of certain subsets, fuzzy sets can be expressed as follows:

$$A = \{(\mu_A(x_i)), x_i\} \tag{8}$$

Where $\mu_A(x_i)$ is membership function[11], if $\mu_A(x)$ that x completely belongs to the set A, And $\mu_A(x) = 0$ means that x not belong to the set A, there A can still be called a fuzzy set of elements. The result of the classification reflects the uncertainty of the classification process, contains more information as the basis for the next level of decision.

On the evaluation conclusions, according to the conditions given evaluation indicators for each object, then according to this decision, evaluation indicators to achieve through the evaluation function f , Common evaluation functions have three forms, functions were weighted average, single factors and highlight the main factors, see equation (9):

$$f = \begin{cases} \sum_{i=1}^{4} a_i x_i, \quad a_i \geq 0, \quad i \leq 4 \\ \bigvee_{i=1}^{4} (b_i \wedge x_i), \quad b_i \in [0,1], \quad i \leq 4 \\ \bigwedge_{i=1}^{4} (c_i T x_i), \quad c_i \in [0,1], \quad i \leq 4 \end{cases} \tag{9}$$

Where a_i, b_i and c_i are normalized weights. In this paper, Evaluation functions using the weighted average.

Off-line signature verification process shown in Figure 1:

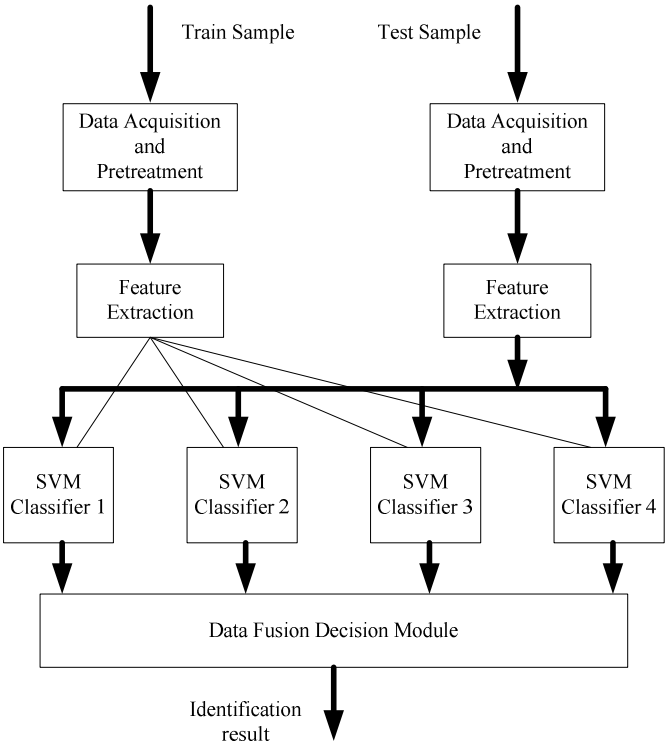

Fig. 1. Off-line Handwritten Signature Verification Process

4 Experimental and Results

1000 off-line handwritten Chinese signatures taken as training samples, structuring Support Vector Machine multiple classifiers combination by the extracting features as the paper described, while all of the extracted features vector to structure a single Support Vector Machine classifier. With 10 off-line handwritten Chinese signatures and 10 pseudo signatures experiment. Measure the results by identifying signature by correct verification rate (CVR) false rejection rate (FRR) and false acceptance rate (FAR). Experiments show that the Support Vector Machine multiple classifiers combination methods that can identify effects than a single Support Vector Machine classifier structured by extracting all the characteristics of signature recognition performance has greatly improved. Experimental data shows in Table 1.

Table 1. Experimental data

Classifier Types	CVR	FRR	FAR
Single SVM Classifier	90.3%	8.2%	7.1%
SVM Multiple Classifiers Combination	97.6%	2.4%	1.2%

5 Conclusion

Signature verification plays an important role in the social life. In the paper, extracted signature features from all aspects with a variety of advantages of signature verification method. By SVM multiple classifiers in parallel combinations, obtained identification results through data fusion decision module. The experimental results show verification effect has been greatly enhanced. But the combination of support vector machine multiple classifiers and integrated decision there is still a lot of ways, and still at the exploratory stage.

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Integrated Group and Single Passengers' Seat Inventory Control in Airline Revenue Management

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Abstract. Group control is very important for the Asian aviation market, especially the Southeast Asian market. By far, there is lack of study about seats inventory control for group passengers in the field of airline revenue management. Seat inventory controls for group passengers and single passengers influence on each other and can not be separated. Considering both of them together, we established a programming model to distribute seats for group passengers and single passengers in this paper. For the model established is non-linear and there is no suitable algorithm, we designed a branch search algorithm to solve it. Empirical results demonstrate the ability of the algorithm to quickly and efficiently solve the model and the ability of the study to improve airline revenue.

Keywords: transportation, revenue management, seat inventory control, group passengers management.

1 Introduction

Group passenger is an important object of revenue management. Group passengers are different from single passengers, they usually cancel some or all the reservation after they made it, sometimes they cancel the reservation just before flight departure, so this will make the airline suffer from financial losses. In addition, after the airline accepts the group bookings, due to lack of seats, they may need to re-arrange some of the single passengers who have already booked. For these reasons, group passenger can not be treated as single passengers. Some airlines, such as Lufthansa, have a special management department for group passengers. They categorized the group passengers into temporary groups, series groups, athletes groups and student tour groups. From revenue management perspective, when the airline is deciding whether to accept a group, they must not determine only according to whether they have the empty seats. First of all, they should predict the group's seat usage and trip rates, find the various available travel routes for the group (in general, the group care about the fare very much, but not for the travel routes and time, unless the competition athletes groups), calculate the fare for the group (the group passengers usually require for a

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greater discount), and then make the decision. The group fare should be based on scientific methods to constitute, and it depends on the fare of single passengers who may be replaced by the group passengers, which is called the single passengers' replacement cost. If there are several different routes that can be used to send away the group, the minimum acceptable fares for each route may be different. The airline should resort to the forecast, and try to arrange the group passengers to the flight which has the emptiest space, and in this way to reduce the single passengers' replacement cost [1]. The method of the single passengers' replacement cost is a very effective way for temporarily group passengers booking decision. But for some routes, such as travel routes, the numbers of groups and passengers of the groups are both biggish, the group passengers make up the main passenger market, and then this method is not applied. As to this kind of route, the reservation of group passengers and single passengers has the significant differences in time, and most of the reservations of group passengers are focused on a short period of time. Because the price of group passengers is lower than single passengers at any time, so in principle, the airline should always give priority to meet the needs of single passengers.

There are very few studies on the problem of group passengers in revenue management currently, and the research has been focused on the single passengers. Littlewoods (1972), according to the classical method of economics — the marginal income approach, put forward the concepts and basic rules of the expected marginal seat revenue (EMSR). Belobaba (1987) developed the method of Littlewoods and gave a strict proving in his doctoral dissertation. Then this method received extensive attention and was called EMSRa method [2]. Tak C. Lee, Marvin (1993) proposed a method of discrete-time dynamic seat inventory control [3]. Curry R. (1990) proposed a method of O-D flow nesting seat inventory control [4].J.C Tan (1994) proposed a method of network seat inventory control based on the air section in his doctoral dissertation [5]. Kalyan Talluri, Garrett van Ryzin (1998) proposed a method of network seat inventory control with bid-price method [6]. None of all these methods had risen to how to make the seat inventory control of group passengers, they all assumed that there are no group passengers or the group passengers can be dismantled in order to be treated as single passengers. All the researches above had weakened the problem of group, on the one hand this is because the flights on foreign airlines have fewer groups, and the group has fewer passengers, so it is feasible to treat the group passengers as the single passengers. On the other hand, the problem of group seats inventory control can not be considered in isolation, and it is interactive with the problem of single seats inventory control. Since the seats on flight can be sold to both the group passengers and the single passengers, so the group passengers and the single passengers have a seats competition relationship. This relationship makes the problem more complicated. But for Asian countries, especially Southeast Asian countries, which have been affected by cultural traditions, the group passengers take a large proportion of flight passengers, so the problem of group seats inventory control should be outstanding, it will be propitious to maximize the flight revenue if the airline makes the group seats and the single seats in integrated control.

2 The Integrative Seats Inventory Control Model for Group Passengers and Single Passengers

Aviation demand is an uncertain demand. For the group passengers and single passengers, since the demand of single passengers has certain regularity, it can be treated as a random vector, and during the current period to the flight closes it always exists within a distribution. Generally speaking, the demand of every sub-compartment is subject to a normal distribution. But the demand of group is uncertain, because the group always makes the reservation to airline very early, and for airline, the demand of group can be achieved exactly when the flight has sufficient seats. In practice, the airline will not decide immediately whether to accept a reservation request from the group, but make a joint decision on a number of groups, and decide to accept which one of them. Therefore, the airline will determine a reasonable conservation number of seats to meet future needs of the single passengers, and then assign the remaining seats to the group passengers. So the airline can choose the best group and accept their reservations, in order to achieve the greatest benefits. The airline must take into account the contribution from the current group to the flight revenue when determining the seats reserved for the single passengers, which will depend on the price, the quantity and the trip rate of the group.

The integrative seats inventory control model for group passengers and single passengers is given as the expressions (1-1)-(1-3).

$$\max \sum_{i=1}^{n} x_i f_i s_i \eta_i + \sum_{i=1}^{c_1} EMSR_i \tag{1-1}$$

$$\text{s.t.} \quad \hat{f}' \times prob\{y \geq c_1\} \leq \overline{f}_{group} \tag{1-2}$$

$$c_1 + c_2 \leq C \tag{1-3}$$

In addition, $x_i = 0,1$, $x_i = 0$ denotes not to accept the group i' s request, $x_i = 1$ denotes to accept the group i' s request, and other variables and parameters are calculated as follows.

$$\hat{f}' = \frac{\sum_{i=1}^{m} f_i \mu_i}{\sum_{i=1}^{m} \mu_i} = \frac{\sum_{i=1}^{m} f_i \mu_i}{\mu} \tag{1-4}$$

$$prob(y > c_1) = \int_{c_1}^{+\infty} \frac{1}{2\pi\sigma} e^{-\frac{(y-\mu)^2}{2\sigma^2}} dy \tag{1-5}$$

$$\overline{f}_{group} = \frac{\sum_{i=1}^{n} x_i f_i s_i \eta_i}{\sum_{i=1}^{n} x_i \eta_i s_i} = \frac{\sum_{i=1}^{n} x_i f_i s_i \eta_i}{c_2} \tag{1-6}$$

$$c_2 = \sum_{i=1}^{n} x_i s_i \eta_i \tag{1-7}$$

The related parameters are defined below.

C : The quantity of available seats on flight, c_1 is the quantity of seats which are allocated to the single passengers, c_2 is the quantity of seats which are allocated to the group passengers;

$F^{'}$: The set of the price of every compartment seats for single passengers on flight: $F^{'} = (f_1^{'}, f_2^{'}, ..., f_m^{'})$, $f_i^{'}$ is the price of the sub-compartment i for single passengers;

F : The set of the price of group requests: $F = (f_1, f_2, ..., f_n)$, f_i is the price of the group i requests;

S : The set of the passengers quantity of group: $S = (s_1, s_2, ..., s_n)$, s_i is the passengers quantity of group i;

η : The set of the trip rate of the group: $\eta = (\eta_1, \eta_2, \cdots, \eta_n)$, η_i is the trip rate of group i;

D : The set of the expected demand for single passengers on flight: $D = (d_1, d_2, ..., d_m)$, d_i is the demand of the sub-compartment i for single passengers, it is subject to independent normal distribution: $d_i \sim N(\mu_i, \sigma_i)$, $\mu = \mu_1 + \mu_2 + \cdots + \mu_m$, $\sigma = \sqrt{\sigma_1^2 + \sigma_2^2 + \cdots + \sigma_m^2}$;

$\sum_{i=1}^{c_1} EMSR_i$: The summation of all the expected marginal seat revenue of seats which are allocated to the single passengers.

The expressions (1-1) is the objective function, the first item is the group passengers' revenue, the second item is the single passengers' revenue, and the objective function wants to maximize the total revenue. The expressions (1-2) requires that the seat revenue of the selected group should not be less than expected marginal seat revenue which is brought by allocating the seats to the single passengers. The expressions (1-2) means that when the expressions is guaranteed to satisfy, it is the optimal allocation of seats for the group passengers and the single passengers, and there is no need to calculate the sum with the group passengers' revenue and the single passengers' revenue. The seats inventory control of every sub-compartment for single passengers could be allocated a maximum number of seats for

single passengers by using EMSRa model. The expressions (1-3) means that the seats that allocated to the group passengers and the single passengers should be no more than the number of available seats on flight.

3 The Algorithm of the Integrative Seats Inventory Control Model for Group Passengers and Single Passengers

It is very difficult to solve the above model, because it is an integer programming problem, and the constraint (1-2) is non-linear, so the traditional knapsack problem algorithm is not fully applied. Because for the different combination of groups, the number of available seats is also different, when the total numbers of the group passengers are the same, the airline should allocate more seats to the group which holds a higher overall price. So it means that the capacity of knapsack problem is a variable. We notice that the right side of the expressions (1-2) is a increasing function of f_i and $s_i \eta_i$, it shows that the group which has a higher price will be easier to satisfy the expressions (1-2) when the sizes of the groups are the same; and the group which has a bigger size will be easier to satisfy the expressions (1-2) when the application prices of the groups are the same.

So the branching search algorithm is established as following:

In the following algorithm steps, for the node K in the algorithm process, SETI(K) is the set of selected groups, SETE(K) is the set of not selected groups, and SETF(K) is the set of not decided groups. Z_0 is the optimal value of the objective function, B(K) is the total revenue of the selected groups in the node K, $WL_k = C - \arg\min_{c_1}\{\bar{f}' \times \Pr(y \geq c_1) \leq \bar{f}_{SETI(K)}\}$ is the limit of the passenger's quantity of acceptable groups, $WL_{\max} = C - \arg\min_{c_1}\{\bar{f}' \times \Pr(y \geq c_1) \leq f_{\max}\}$ is the maximum passengers' quantity of the acceptable groups currently, $WL_{\min} = C - \arg\min_{c_1}\{\bar{f}' \times \Pr(y \geq c_1) \leq f_{\min}\}$ is the minimum passengers' quantity of the acceptable groups currently, and f_{max} is the highest application fare for group passengers, f_{min} is the lowest application fare for group passengers. And we define that if a node will not be pruned and has no branches, then we call it the tail node.

Step 1: if $\min_i \{s_i \eta_i\} > WL_{\max}$, then there is no feasible solution exists, end calculating; or turn to the next step.

Step 2: if $\sum_{i=1}^{n} s_i \eta_i \leq WL_{\min}$, then all groups are acceptable, end calculating; or turn to the next step.

Step 3: sort the groups in descending order according to their application price fi, if there are several groups have the same application price, then sort them in descending order according to $s_i \eta_i$, and turn to the next step.

Step 4: set B(1)=10^8, SETI(1)= Φ, SETE(1)= Φ, SETF(1)={1,2,3…,n}, K=1, and turn to the next step.

Step 5: in the set of the tail node, set K to denote the node of which B(k) is maximal, select node K to branch, if SETF(K)=Φ(all the groups have been selected or have been removed), then the optimal solution has been found, the maximum value of the total group revenue is equal to $Z_0 = \sum_{i \in \mathrm{SETI}(K)} f_i s_i \eta_i$, end calculating; or turn to the next step.

Step 6: branch node K according to the application price, set ISTAR to denote the group which holds the highest application price in I∈SETF(K), so one of the branches contains group ISTAR, and another one contains the remaining groups in SETF(K) after removing group ISTAR. Set the next branch's number to K=K+1, and at the same time set COUNT=1, SETI(K)=SETI(K-1), SETF(K)=SETF(K-1)-ISTAR, SETE(K)=SETE(K-1) ∪ ISTAR. Turn to the next step.

Step 7: calculate B(K): set a temporary set SETI'(K), copy SETI(K) to SETI'(K), if SETF(K)≠Φ, then select the groups in SETF(K) as many as possible in descending order according to their application price, move them to SETI'(K), calculate WLK with the groups of SETI'(K), until the passengers' quantity of all the selected groups is equal to WLK, we notice that this algorithm may lead the last group can not be moved into SETI'(K) completely. Set the value of all the groups' total revenue to B(K), so B(K) has actually become the upper bound of all the nodes which branches from this node. If COUNT=1, turn to the next step, or turn to step 5.

Step 8: consider the nodes which contain group ISTAR. Set K=K+1, SETI(K)=SETI(K-2) ∪ ISTAR, SETE(K)=SETE(K-2), SETF(K)=SETF(K-2)-ISTAR, COUNT=0, calculate WLK, if $\sum_{i \in \mathrm{SETI}(K)} s_i \eta_i \le WL_K$, then turn to step 7; or set B(K)=0, turn to step 5.

In the algorithm above, WLK has the significance of c2, it denotes the number of available seats which remained to the groups after considering the demand of single passengers as much as possible. In the process of constantly branching, the groups in SETI(K) are increasing gradually, the average price of groups is decreasing gradually, therefore, the quantity of seats c1 which are reserved to the single passengers is increasing gradually, the quantity of available seats for group passengers WLK is decreasing gradually. However, after the branching gets to a certain level, WL_K is changing tardily, and the variation is generally between 2-5 seats.

4 A Empirical Study

Suppose that there is an airline, and the price of a flight of this airline for single passengers is 60% discounts currently, the demand and the price of future single passengers is predicated as Table 1. The price, the quantity and the trip rate of the application groups currently are showed in Table 2. The quantity of remaining available seats on flight currently C=124. We need to decide which groups should be accepted.

Table 1. The demand of single passengers

Level of passenger compartment	1	2	3	4	5
Price (discount)	0.6	0.7	0.8	0.9	1.0
Expected value of demand	12	14	14	10	6
Standard deviation of demand	3	5	6	4	3

Table 2. The demand of group passengers

Group number	**Price (discount)**	**Quantity of passengers**	**Trip rate**
1	0.55	10	0.9
2	0.55	15	0.85
3	0.5	20	1.1
4	0.45	24	0.96
5	0.45	16	1.05
6	0.4	30	0.75
7	0.5	12	0.95
8	0.55	8	1.2
9	0.5	18	0.98
10	0.35	35	0.92

With the data of single passengers in Table 1, the data of group passengers in Table 2 and the algorithm above, we make the program of the mathematical model (1-1) - (1-7) with MATLAB programming language, calculate the solution by using a notebook computer (1.6GHz 512MB RAM), and it takes 0.54ms. The result shows that the optimal strategy for the groups to accept is (2, 8, 1, 3, 9), expected revenue is 37.48p (p is the full price of ticket), 74 seats are allocated to the group passengers, actually 70 seats are expected to sell, 50 seats are remained to single passengers, and there may be 4 vacant seats. But the vacant seats do not mean that they will certainly be wasted, if these seats still are vacant before the flight take-off, they can be extracted to sell.

If the group numbers given in Table 2 is in the order that the groups requested, generally, the airline accepts the groups in accordance with the principle of "first-come, first served" as a strategy, then the groups to accept is (1, 2, 3, 4), expected revenue is 33.33p, 69 seats are allocated to the group passengers, actually 67 seats are expected to sell, 55 seats are remained to single passengers, and there may be 2 vacant seats. So this will reduce the revenue of 4 full price tickets than the optimal solution of the method above. If the airline accepts the groups in accordance with the principle of "price priority, quantity priority" as a strategy, then the groups to accept is (1, 2, 8, 3, 5), expected revenue is 35.8p, 70 seats are allocated to the group passengers, actually 70 seats are expected to sell, and there is 0 vacant seat. So this will also reduce the revenue of 1.68 full price tickets than the optimal solution of the method above; or the airline can accept the groups (2, 3, 5, 7, 8), expected revenue is 36.55p, 73 seats are allocated to the group passengers, actually 73 seats are expected to sell, 51 seats are remained to single passengers, and there may is 0 vacant seat. At this time, despite there is 0 expected vacant seat, it will still reduce the revenue of 0.93p than the optimal solution.

The revenue of the integrative seats inventory control for group passengers and single passengers is so small if only simply for one fight, but for a medium-sized airline, there will be at last 500 fights for just one day. If 20% of flights one day have the problem of huge group passengers, the quantity of flights will be 100. Generally, the air fare for full price is between RMB1,000 and RMB 2,000, even at the lowest price it will bring the airline RMB 10,000 for revenue for one day, and RMB 36,000,000 for one year, this will be very significant!

5 Conclusion

This paper established a method for the integrative seats inventory control model for group passengers and single passengers in the airline revenue management, and proposed a static control model. As the model is a nonlinear model which lacks of ready-made solution method, this paper designed a branching search algorithm. The empirical study shows the model is correct, the algorithm is accurate, the efficiency of solution is high, and it has a practical value.

The technology of seats inventory control in revenue management is developing towards to the direction of dynamic and network more and more, so the integrative dynamic seats inventory control for group passengers and single passengers and the integrative network seats inventory control for group passengers and single passengers are the direction for further research.

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Optimal Decision on Length of Waiting List in Airline Revenue Management

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Abstract. Multiple nested fare classes in revenue management can improve revenue level in civil aviation. But it is strictly dependent on an accurate grasp of the needs, which is nearly not achieved. This paper presented a nonlinear stochastic optimization model for study optimal arrangement of waiting list's length, in which the number of left seats and the state of subclass open and closed are the state variables and waiting list's length is the decision variable. The model was based on the proposed six basic assumptions by analysis of waiting list implemented condition. The optimized length of the waiting list was solved by one-dimensional search algorithm. Empirical results demonstrate that waiting list has two basic rules. Rule one, the length of waiting list and waiting revenue is decreasing function of passengers arrival rate; rule two, the decrease of the wait list's length and the waiting revenue will be less when the arrival ratio of passengers be more and more. And empirical results also show that optimal waiting list can improve the airlines revenue.

Keyword: revenue management, waiting list, transportation, optimization model.

1 Introduction

With the large implement of the multi-class selling rule of revenue management in civil aviation industry, airlines have only two alternative choices, receipt or refuse, when they face passengers [1]. If the subclass is still open, an airline receives reservation. If it closes, an airline refuses reservation. The refused passenger have to reserve the higher class tickets or buy other airlines' tickets or change the way of transportation[2].The airlines make the receipt or refuse decision based on whether the passengers with higher price demand will appear[3]. If it does, airlines needn't leave the seats to meet the need of reservation. However, the future need have uncertainty. The longer time is, the greater uncertainty is. Therefore, there are usually plenty of available seats appearing before the departure of a flight. So airlines have to consider solving this situation often happening, but no satisfied ways have been found for so many years.

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In 2005, Singapore Airlines first designed a waiting list rule. When a passenger made reservation request, the airline could inquire whether a passenger was willing to wait for while if related subclass had closed. If the demand of other subclass was less than expected during this time, these available seats could be supplied to the waiting passengers in priority. If there were no available seats before the ending of waiting time, the airline needed to inform the passenger in time that the passenger needed not wait. Carrying out the waiting list rule, the airline can have a better ability to adapt to the future need. But there was a problem brought to the airline: if plenty of passengers were in vain after waiting, the reputation of airline would be affected. Therefore, the arrangement of waiting list's length becomes critical. In this paper, the optimization problem of waiting list's length was studied.

2 The Basic Assumptions and Variables Description

Assumption 1: an airline arranges a waiting list of all subclass which are lower than certain price. The demand of high-price subclass shows the time sensibility of passengers [4]. If this subclass is closed, passengers have to buy higher price tickets or transform to other airlines.

Assumption 2: all kind of subclasses are sold in the same time, but the arrival rate of passengers differs. The less price of subclass is, the higher arrival rate of passengers is. The time of close of lower subclass is prior to that of higher subclass. The demands of all kinds of subclass passengers are independent [5].

Assumption 3: As to the subclass having set a waiting list, the lower the price of subclass is, the longer the waiting time of passengers is.

Assumption 4: when the future demand of passengers has been clear or almost clear at some time before departure of a flight, the airline have to arrange the passengers in the waiting list to buy tickets or inform them inability of buying tickets. Define this moment as the voidance time of waiting list.

Assumption 5: the reputation of the airline will be affected if the waiting passenger can not buy a ticket. The affected level can be calculated by currency.

Assumption 6: No overbooking and ticket-returning happens for a flight [6].

Variables are described as follow:

C : The number of available seats of a flight;

I : The number of subclasses set for a flight, I_H is the supreme subclass of a waiting list, obviously $I_H < I$;

T_c : The voidance time of a waiting list

i : Subclass i of the flight. The smaller i is, the lower price of subclass is;

W_i : The willing waiting time of passengers for i subclass, $i = 1,2,...,I_H$;

t : The time before departure of a flight. If t is equal to 0, it means it is the departure time of a flight;

$C(t)$: The number of the remaining seats of a flight at t moment;

$S(t)$: The number of seats sold at t moment;

$S_i(t)$: The number of seats sold for subclass i at t moment;

$L_i(t)$: The selling limits of subclass i at t moment;

$\lambda_i(t)$: The arrival rate of passengers of subclass i at t moment;

$I_C(t)$: The set of closed subclasses at t moment;

$I_O(t)$: The set of subclasses still opening at t moment;

$U(t)$: The length of a waiting list at t moment;

$U_i(t)$: The number of passengers waiting for buying subclass i tickets at t moment, $U(t) = \sum_i U_i(t), \quad i \in I_C(t)$;

V: The cost risen from affected reputation due to a passenger's inability in buying a ticket;

x_i: The number of seats sold of subclass i from C moment to the departure time of the flight;

R: The revenue of a waiting list;

The mathematical model of length of waiting list is described below:

At t moment, if $I_C(t) = \phi$, $U(t) = 0$.

At t moment, if $I_C(t) \neq \phi$, assume that $I_C(t) = \{1,2,...,i\}$, for $j \in I_C(t)$,

while $\Delta = (T_c - t) - W_j \geq 0$, $U_j(t) = 0$;

While $\Delta = (T_c - t) - U_j < 0$, $U_j(t) > 0$.

This demonstrates that whether waiting passengers to buy tickets exist depends on the patience of them. If the waiting time is too long, passengers may give up waiting. Only if the actual waiting time is less than that of willing to wait, a passenger may wait to buy at time of t.

According to the reservation situation at that time, the number of reserved seats and the passenger arrival rate of subclass can be observed. The arrival of passengers obeys the Poisson distribution, so the probability that the seats of all subclass are sold is showed as follows:

$$P\{x_i = n_i\} = e^{-\lambda_i(t).t} \frac{[\lambda_i(t) \cdot t]^{n_i}}{n_i!} \qquad 0 \leq x_i \leq L_i(t) - S_i(t) \tag{1}$$

The number of remaining seats can be expressed as follows:

$$C(t) = C - \sum_{i=1}^{I_H} S_i(t) \tag{2}$$

While the number of passengers arriving in the future $X = \sum_{1}^{I_H} x_i < C(t)$, the passengers in the waiting list have the chance to buy tickets and it can take revenue to airlines. Let $\overline{P}$ be the average price of the waiting list while $U(t) > 0$, then waiting passengers bring the revenue shown as follows:

$$R = \begin{cases} (C(t) - X)\overline{P} - [U(t) - (C(t) - X)]V \\ \qquad U(t) \geq C(t) - X \\ U(t)\overline{P} \\ \qquad U(t) < C(t) - X \end{cases} \tag{3}$$

Therefore, the expected revenue is

$$\begin{aligned} &\max_{U(t)} E(R) = P\{U(t) \geq C(t) - X\} \\ &\times \{(C(t) - X)\overline{P} - [U(t) - (C(t) - X)]V\} \\ &+ (1 - P\{U(t) \geq C(t) - X\}) \times U(t)\overline{P} \\ &= \sum_{n=0}^{U(t)} P\{C(t) - X = n\} \times [n\overline{P} - (U(t) - n)V] \\ &+ \sum_{n=U(t)+1}^{C(t)} P\{C(t) - X = n\} U(t)\overline{P} \end{aligned} \tag{4}$$

St :

$$0 \leq U(t) \leq C(t) \tag{5}$$

$$n = 0,1,..,C(t) \tag{6}$$

The objective function is a nonlinear stochastic optimization function. Formula (5) shows that the length of waiting list is no more than the number of remaining seats. $P\{C(t) - X = n\}$ means the probability that there are n available seats when the flight departs. According to the assumption 2, while $0 \leq n \leq BL_I$, there are available seats in subclass I. While $BL_I \leq n \leq BL_I + BL_{I-1}$, there are available seats in the I and I-1 subclass.

While $0 \leq n \leq BL_I$,

$$\begin{aligned} &P\{C_t - X = n\} = P\{x_I = BL_I - n\} \\ &\times \prod_{i \in I_O(t)} P\{x_i \geq BL_i(t) - S_i(t)\} \end{aligned}$$

While $BL_I \leq n \leq BL_{I-1} + BL_I$,

$$
\begin{aligned}
&P\{C_t - X = n\} \\
&= P\{x_{I-1} + x_I = (BL_{I-1} + BL_I) - (S_I(t) + S_{I-1}(t)) - n)\} \\
&\times \prod_{i \in I_o(t)} P\{x_i \geq BL_i(t) - S_i(t)\}
\end{aligned} \tag{7}
$$

Similarly, the probability that there is various number of available seats can be calculated.

3 An Empirical Study

Suppose the full price of a flight ticket is RMB2, 000, we set a subclass for every discount from the 40% discount, and there are 7 subclasses. The waiting list will be set below 70% discount (including 70% discount). The quantity of the available seats on flight is 200. There are 10 days before the waiting list gets invalid, and 13 days before the flight departs at the moment, the airline thinks that the cost risen from affected reputation due to a passenger's inability in buying a ticket is RMB200. Table 1 shows a variety of information required for determining length of waiting list. As it can be seen from Table 1, the subclass 1 and 2 are both acceptable to the waiting passengers at this time, the average price is RMB900. After calculation, the result is that the waiting list will bring the maximum expected revenue when $U(t) = 14$, the value is RMB2,544.8.

Table 1. SubCLASS states of flight

Subclass	1	2	3	4	5	6	7
Price (RMB)	800	1000	1200	1400	1600	1800	2000
Discount (%)	40	50	60	70	80	90	100
Limit quantity of selling seats (seats)	44	36	32	30	24	20	14
Quantity of seats sold (seats)	44	36	24	18	10	8	4
State of subclasses	closed	closed	open	Open	open	open	open
Arrival rate of passengers (persons/day)	4.6	3.8	2.7	1.8	1.5	1.3	0.8
Willing wait time (days)	18	16	12	8	——	——	——

For the data in Table 1, all the parameters except for the arrival rate of each subclass's passengers remain unchanged, we set several passenger arrival rates, and the length of the waiting list and the expected revenue for each passenger arrival rate is calculated in Table 2.

As seen from Table 2, there are the two rules. Rule one: the length of the waiting list and the waiting revenue is a decreasing function to the passenger arrival rate; rule two: the quantity of the length of the waiting list and the waiting revenue reduced while the passenger arrival rate increasing is gradually decreasing. Rule one shows that when the passenger arrival rate increases, the possibility of the appearance of vacant seats before the flight take off will get smaller, so the length of the waiting list will shorten, and the revenue from the tickets of waiting passengers will reduce. Rule two shows that the waiting list has such a nature, even if the possibility of the

appearance of vacant seats before the flight take off is very small, the airline will still be beneficial generally if a fair amount of the waiting passengers are reserved. This shows that the waiting list system will increase the airline's revenue.

Talbe 2. Waiting list's length and expected revenue under different passenger's arrival rate

Proportion of passenger arrival rate	Length of waiting list	Expected revenue	Proportion of passenger arrival rate	Length of waiting list	Expected revenue
0.900	18	3686.6	1.010	9	2400.2
0.925	18	3350.6	1.020	9	2369.5
0.950	16	3051.4	1.025	9	2216.2
0.975	16	2781.7	1.050	9	2064.2
1.000	14	2544.8	1.075	9	1914.9
1.005	12	2463	1.100	9	1769.5

PS: the proportion of passenger arrival rate is based on the passenger arrival rate in Table 1.

4 Conclusion

In this paper, we established an optimal mathematical model for the control of the waiting list, and calculated the optimal length of the waiting list with one-dimensional search algorithm. We summarized two basic properties of the length of waiting list from the empirical study, and verified that the waiting list system could increase the airline's revenue level. However, this model still has some disadvantages. The first one is that the model decides the present optimal length of the waiting list only according to the current sale of each subclass's seats, but not from the entire sales process. It dose not consider the situation in which the passengers are willing to wait when the subclass is closed. The second one is that the model doses not consider the situation that some passengers in the waiting list may stop waiting, and it will increase the length of waiting list in this case. If both the situations are considered, the problem of optimal waiting list's length will be turned into a dynamic control problem.

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Research of Medical Image Variable Step-Size Blind Restoration Algorithm

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Abstract. A novel adaptive variable step-size constant module medical CT image blind equalization algorithm was proposed. The process of image restoration transformed by a linear operation is equivalent to one dimensional blind equalization. The constant modulus blind equalization cost function applied to medical CT image was founded. The kurtosis of error signal was utilized as step-size control factor to speed up the convergence and improve the performance of the algorithm. Computer simulations show that new algorithm improves peak signal to noise ratio, restoration effects and efficiency of operations, and decrease state residual error.

Keywords: blind equalization, constant module algorithm, CT image, Kurtosis, variable step-size.

1 Introduction

Without any training sequence, blind equalization algorithm only makes use of receiving sequence's transcendent knowledge to poise the idiosyncrasy of channel and make the output sequence of equalizer be close to the sending sequence. It is an important frontier hot research topic in the domain of communication, signal and information processing, detection theory and other disciplines. It has been widely utilized in communications, radar, sonar, control engineering, seismic exploration, biomedical engineering and other fields. In the existing blind equalization algorithm, the most widely used algorithm is the constant modulus blind equalization algorithm, which generally adopts a fixed step size, and the convergence speed and steady-state residual error become contradictory.

Medical CT image reflects the degree that the organs and tissues absorb X-ray. It benefits discovering small lesions of microstructure in vivo. And it is a most important assistant means in the field of medical image diagnosis. However, in the process of imaging and transfer, due to the image affected the two-dimensional channel, namely point spread function, and the image blurring will carry out. The

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degraded CT images will have an influence on affecting normal display and diagnostic accuracy. Nevertheless, in nature, the process of the CT image degradation is often unknown. Blind image restoration is that, in the case of unknown degradation information, interference and noise are removed, the lost image will be recovered, and the restored image approaches the original image as much as possible.

Constant modulus algorithm is a classical algorithm [1], and it was widely used in various field of blind equalization. This paper utilized the similarity between the process of image degradation and inter-signal interface. On the base of the literature [2], a variable step-size constant modulus image blind equalization algorithm based on dimension reduction was proposed. Dimension reduction was used to complete transforming from two-dimensional image signal into a one-dimensional complex signal sequence. The constant modulus cost function was established. The strategy of variable step-size was introduced to improve the convergence properties of constant modulus algorithm. The optimal estimation of the dimension reduction signal was obtained, and then images estimate were obtained by dimension rising. The method completed the restoration of the image by sophisticated constant modulus blind equalization algorithm, avoided the two-dimensional matrix inverse iteration operation, reduced the complexity of the algorithm, and effectively eliminated the impact of the point spread function. Image restoration has well been carried out. Simulation results verify the effectiveness of the algorithm..

2 MAth Model

Degraded image g_{ij} is engendered the original image f_{ij} that passes a point spread function system h_{ij}, and it was added by noise n_{ij}. In order to facilitate the discussion, set the point spread function is a linear time-invariant system. As is shown in Figure.1.

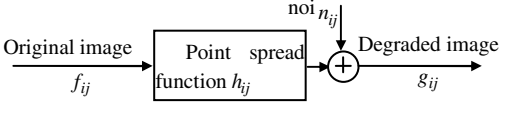

Fig. 1. Model of degraded image

$$\begin{aligned} g_{ij} &= f_{ij} * h_{ij} + n_{ij} = \sum_{u=0}^{A-1}\sum_{v=0}^{A-1} f_{u,v} h_{i-u,j-v} + n_{ij} \\ &== \sum_{u=0}^{A-1}\sum_{v=0}^{A-1} h_{u,v} f_{i-u,j-v} + n_{ij} \end{aligned} \tag{1}$$

Where, $i, j = 0,1,2\cdots M-1$, $A \times A$ is size of point spread function.

In order to utilize blind equalization technology pass to realize medical CT image restoration, firstly, two-dimensional medical CT images should be transformed into one-dimensional row or column sequence. However, a single row or column transform weakened blind equalization algorithm's ability that overcomes point spread

function's affect. This paper proposed an image blind equalization based on simultaneous row and column signal transform. The block diagram is shown in Figure.2.

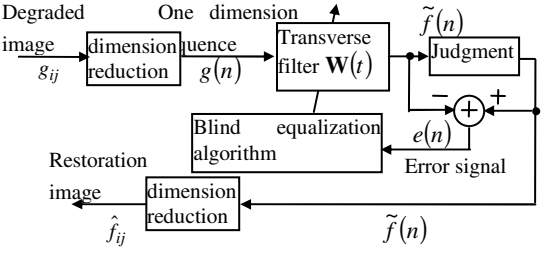

Fig. 2. Principle block diagram of blind equalization algorithm

In the Figure, $\mathbf{W}(n)$ is the weight vector of blind equalizer; $g(n)$ is one-dimensional signal sequence that the image was transformed into by dimension reduction; $\tilde{f}(n)$ is the restoration signal of blind equalizer output; $\hat{f}(n)$ is the output of the estimator; $\hat{f}_{ij}$ is the estimator of the image.

In the process of image dimension reduction by row transform, so that

$$g(n) = g_{ij} \tag{2}$$

Where, $n = 0,1,2,\cdots,\ M^2 - 1$; $j = ((n))_M$, $M \times M$ is the size of image. $((n))_M$ is the remainder operation expression, and it expresses the residual value of n module M ; $iM + j = n$.

The transversal filter in the algorithm is expressed as

$$\mathbf{W}(n) = [w_0(n)\ ;\cdots,\ w_r(n),\ \ ;\cdots,\ w_{L-1}(n)]^{\mathrm{T}} \tag{3}$$

Then

$$\tilde{f}(n) = \sum_{r=0}^{L-1} w_r(n) g(n-r) \tag{4}$$

In order to satisfy equation (4), the input sequence vector $\mathbf{G}(n)$ of the transversal filter is expressed as

$$\mathbf{G}(n) = [g(n), g(n-1)\ ;\cdots,\ g(n-L+1)]^{\mathrm{T}} \tag{5}$$

Thus, equation (4) can be written as

$$\tilde{f}(n) = \mathbf{W}^{\mathrm{T}}(n)\mathbf{G}(n) \tag{6}$$

In order to obtain the optimal image and the optimal solution of $\mathbf{W}(n)$, its solution is similar to one-dimension equalization. Image was carried out by dimension reduction to solve $\mathbf{W}(n)$. The cost function of $\mathbf{W}(n)$ was established and optimized to obtain the

optimization solution. To obtain the restoration image, firstly, the corresponding restoration sequence $\hat{f}(n)$ was obtained, and then the corresponding estimate of the image by inverse transform is obtained, that

$$\hat{f}_{ij} = \hat{f}(n) \tag{7}$$

Where, $n = 0,1,2,\cdots,\ M^2 - 1$; $j = ((n))_M$, $iM + j = n$.

3 Variable Step-Size CMA Imgae Blind Equalization Algorithm

Digital medical CT images are grayscale, and independent with the distribution [3]. C. Vural firstly proposed a two-dimensional constant modulus cost function to realize image restoration. In this paper, the ideological dimension reduction was adopted. The newly CMA cost function is

$$J(n) = \mathrm{E}\left[\left(\left|\tilde{f}(n)\right|^2 - R_2\right)^2\right] \tag{8}$$

Where, R_2 depends on fourth-order statistics of one-dimensional signal sequence formed by two-dimensional image. When statistical information of the image is known, R_2 is a constant.

In practice, the expectation value of variable can not been calculated. The instantaneous value of the solution often was utilized to replace the statistical average value. The above equation can be transform into,

$$J(n) = \left[\tilde{f}^2(n) - R_2\right]^2 \tag{9}$$

According to LMS method, weight iteration formula of medical CT images constant modulus blind equalization based on row-column transform were obtained.

$$w_r(n+1) = w_r(n) - \mu \frac{\partial J(n)}{\partial w_r(n)} \quad r = 0,1.\cdots, L-1 \tag{10}$$

Where, μ is the step factor.

From (10) can be obtained

$$\begin{aligned} \frac{\partial J(n)}{\partial w_r(n)} &= \left[\tilde{f}^2(n) - R_2\right]\tilde{f}(n)\frac{\partial \tilde{f}(n)}{\partial w_r(n)} \\ &= \left[\tilde{f}^2(n) - R_2\right]\tilde{f}(n)g(n-r) \end{aligned} \tag{11}$$

Iterative weight vector can be described by the vector form as following.

$$\mathbf{W}(n+1) = \mathbf{W}(n) - \mu\left[\tilde{f}^2(n) - R_2\right]\tilde{f}(n)\mathbf{G}(n) \tag{12}$$

The shortcoming of the traditional constant modulus algorithm is slow convergence. From equation (12) can be seen, the algorithm adopted a fixed step size. The larger step size is, the quicker convergence speed is, but the larger step size causes large

steady residual error. The small step size can reduce steady residual error and increase the convergence precision, but at one time it depresses convergence speed and tracking capacity, or even results in divergence algorithm. In order to resolve the contradiction, the fixed step size was replaced by a variable step size. Variable step size image blind equalization algorithm was put forward. In the other word, the step size was increased during the diffusion of the algorithm; the step size was reduced after the convergence of the algorithm to improve the accuracy of convergence.

In order to achieve variable step size constant modulus blind equalization algorithm, the step size factor μ should be a function of a variable parameter, and during the convergence of algorithm, the parameter possesses gradually change in the trend.

The kurtosis of error signal was utilized as step size factor control variable in this paper. Because in the convergence process, the error signal kurtosis should be gradually reduced, that is, when the error signal kurtosis grow larger and the step size increases to speed up the convergence, when the kurtosis value of the error signal is small, the step size decreases to guarantee the performance after convergence. The variable step size was expressed as

$$\mu(n) = \alpha \left| K\left[e(n)\right] \right| \tag{13}$$

Where, α is the scale factor; $K\left[e(n)\right]$ is the kurtosis of the error signal, it was expressed as [4]

$$K(n) = \mathrm{E}\left[\left|e(n)\right|^4\right] - 2\mathrm{E}^2\left[\left|e(n)\right|^2\right] - \left|\mathrm{E}\left[e^2(n)\right]\right|^4 \tag{14}$$

Where $e(n)$ is error between the equalizer output signal and its estimated. That

$$e(n) = \hat{f}(n) - \tilde{f}(n) = \hat{f}(n) - \mathbf{W}^{\mathrm{T}}(n)\mathbf{G}(n) \tag{15}$$

Equation (13) was introduced into formula (12), and the variable step size constant modulus algorithm blind equalization based error signal kurtosis was obtained. Then

$$\mathbf{W}(n+1) = \mathbf{W}(n) - \alpha \left| K\left[e(n)\right] \right| \left[\tilde{f}^2(n) - R_2\right] \tilde{f}(n)\mathbf{G}(n) \tag{16}$$

By equation (16), the optimal estimation of dimension reduction sequence can be obtained, and the optimal estimation of the reconstructed image was obtained. However, in order to ensure effective convergence of the algorithm, the maximum step size must not exceed the upper limit of step factor, and thus the parameter value of should be reasonably selected.

4 Simulation

In order to validate the algorithm, the experiment adopted 8-bit, the size of 256 × 256, CT images. The degradation of CT image is an approximate Gaussian process [5], the point spread function is taken as 15 × 15 Gaussian matrix, and its variance is 0.1. The original image passed through the point spread system, and the degraded image was added by Gaussian white noise with mean 0 and variance 0.008. It was shown in Figure.5.

In the simulation, the order of the transversal filter is 21, and its initial value was $[0,\cdots,0,1,0,\cdots 0]^{\mathrm{T}}$; $R_2 = 39320.0$; $\alpha = 0.05$.

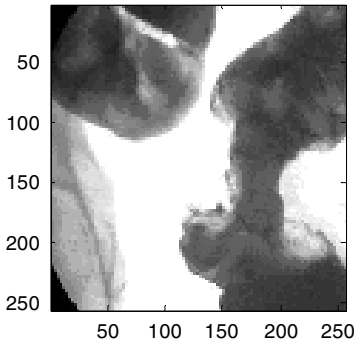

Fig. 3. CT image

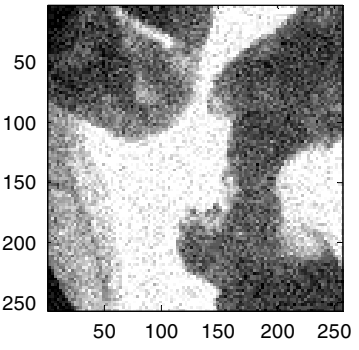

Fig. 4. Degraded image

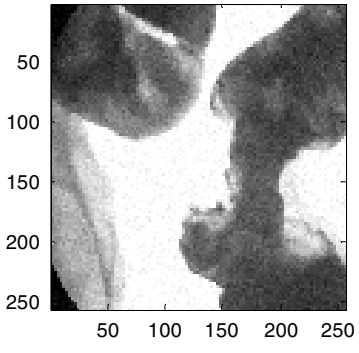

Fig. 5. Result of IBD method

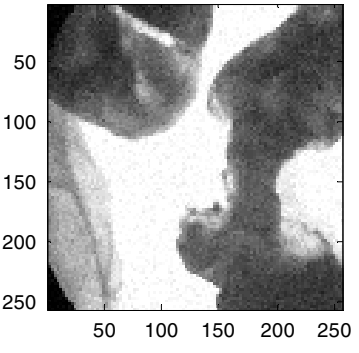

Fig. 6. Result ofconstant module algorithm

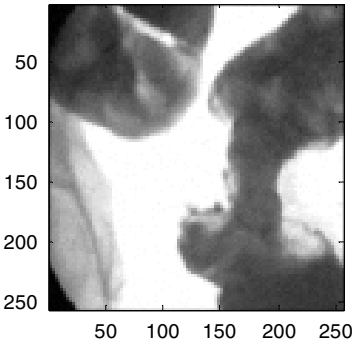

Fig. 7. Result of this paper

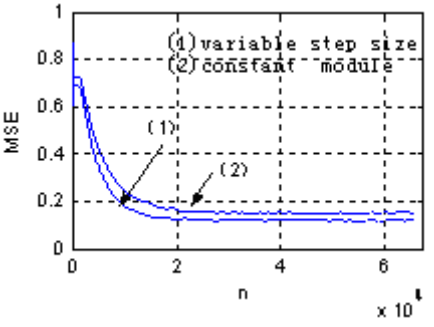

Fig. 8. Curce of convergence

The iterations number of IBD is 100, the result is shown in Figure.5[6]. Figure 6 is the restoration of constant modulus blind equalization algorithm. Figure 7 is the restoration image of the proposed variable step size CMA blind equalization algorithm. Figure 8 shows that the proposed algorithm improves the convergence speed and reduces the steady-state residual error.

Table 1 shows peak signal to noise ratio of different blind restoration at the same simulation condition. PSNR describes the approximation level that the restoration image approaches the target image. The higher the peak signal to noise ratio is, the better the effect of the restoration is. In other words, the restoration image is closer to the image.

$$\mathrm{PSNR} = 10\lg\frac{255^2}{\frac{1}{M^2}\sum_{i=0}^{M-1}\sum_{j=0}^{M-1}\left[f_{ij}-\hat{f}_{ij}\right]^2} \tag{17}$$

Table 1. Compare PSNR of various of algorithm

	Variable step-size algorithm	Constant module algorithm	IBD algorithm
σ_n^2 =0.001	23.226	23.166	23.465
σ_n^2 =0.005	23.123	23.064	23.078
σ_n^2 =0.008	23.063	22.954	22.676
σ_n^2 =0.01	22.976	22.863	22.566

Table 1 shows that compare the variable step size constant modulus blind equalization algorithm and constant modulus algorithm, the peak signal to noise ratio was not obviously improved. Since the calculation of step size factor was introduced, and the operational cost of the algorithm also was increased. However, the algorithm possessed faster convergence. IBD blind restoration algorithm possesses better restoration performance in low SNR, but the alternative iteration requires a lot of cost. It is not conducive to real-time implementation, and more affected by noise. Compared with IBD algorithm, the algorithm in this paper and constant module algorithm has better robust to noise.

5 Conclusion

Constant modulus blind equalization algorithm in the communication system was applied to blind image restoration. Firstly, dimension reduction was utilized to transform the image into one-dimensional signal. The cost function of constant modulus applied to image restoration was constructed. In order to overcome the defects of constant modulus algorithm, slow convergence, the kurtosis of error signal was utilized to control step size factors, speed up the convergence rate. The method has avoided matrix inverse image computation with a large dimension, and reduces the amount of computation. Simulation results show the effectiveness of the algorithm, the algorithm not only gets better in the restoration effect and improves the peak signal to noise ratio, and obtains better convergence.

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Application of Improved Classical Blind Equalization Algorithm in Seismic Signal Processing

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Abstract. A seismic blind equalization algorithm based on constant modulus algorithm was proposed to obtain seismic wavelet. The constant modulus blind equalization cost function applied to seismic signal was founded. The update of the weight vector was completed by introducing the second order Hessian matrix of cost function. The convergence rate was speeded up, and the performance of constant modulus algorithm was improved. Computer simulations demonstrate the effectiveness of the algorithm. Simulation results show the effectiveness of the algorithm. This method adapts to the non-minimum phase system, gets the optimal estimation of original reflection coefficient, and possesses quick convergence and high precision. It is an effective means to improve the analysis of seismic data.

Keywords: blind equalization, constant module algorithm, seismic data, fractional lower-order statistics, cost function.

1 Introduction

Digital processing of seismic data is aimed to analyze the seismic field data, and thus restore more precise seismic signals with zero phases and certain frequency range. It describes the arrival time that source wavelet arrives at the reflection interface position as accurately as possible to improve the signal to noise ratio and the accuracy of seismic data, and facilitate researchers explained.

In the seismic exploration, when seismic wavelet that excited by stimulate points on the surface transmitted to the ground and faced with the ground impedance interface, a part of the energy will be reflected back surface as a reflection of seismic waves. They are received by ground sensors. Along with seismic wave continuing down the propagation, reflection, receiving, it will record a series of time delay of seismic waves (seismic wavelet filtered by ground), and it was known as the earthquake records [1]. Wavelet restoration technology is an important issue in seismic data processing and paid widely attention to. The quality of wavelet estimation directly affects the effects of data processing.

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The seismic waves and reflection coefficient are usually unknown, so the de-convolution of seismic signal is a blind process. In 1987, Wiggins RA [2] firstly proposed the minimum entropy de-convolution method to solve the problem of seismic signal. Later, many of researchers proposed a series of method that obtained seismic waves and reflection coefficient only from records' own characteristics of the earthquake, that is, "seismic blind de-convolution." So far, the seismic signal blind convolution methods mainly include methods such as maximize the likelihood ratio of blind de-convolution method based on information theory, minimum entropy adaptive blind de-convolution method based on information theory, sparse Bayesian blind anti-inversion convolution based on the traditional framework, sparse blind de-convolution based on independent component analysis, and so on. Maximize the likelihood ratio of blind de-convolution method based on information theory fits the probability distribution of the reflection coefficient sequence by constructing a likelihood ratio of different objective functions. Anthony L [3] proposed a frequency domain blind de-convolution algorithm based on minimum mutual information. Minimum entropy adaptive blind de-convolution method based on information theory defines the objective function as a form of relative entropy. The objective function will be changed during the iterative process at each step. The natural gradient algorithm blind de-convolution proposed by Liu cai et al [4] gave iteration formula of seismic blind de-convolution by introducing a compensation function. Sparse Bayesian blind anti-inversion convolution based on the traditional framework generally export a Toeplitz matrix of linear systems. The solution was completed by matrix inversion, Levinson recursion and conjugate gradient method. However, the big step number of Toeplitz matrix may lead to ill-conditioned problems, poor numerical stability and even no the optimal solution. In conjugate gradient method, such problem can be solved if a regularization factor adopted the diagonal elements of the matrix. However, the problem of numerical stability and accuracy can not be completely solved. A sparse blind de-convolution mathematical framework proposed by Canadas E [5] constructed blind de-convolution objective function by founding the fitting error of least squares and reflection coefficient regularization constraint term. and then, seismic wave and reflection coefficient were solved by efficient optimization iteration algorithms. Zhang Fanchang et al [6] compared several commonly used sparse constraints, and a better balance between in enhancing the seismic data resolution and reduce the suppression of weak reflectors was obtained by establishing the modified reflection coefficient Cauchy sparse constraints . Sparse blind de-convolution based on independent component analysis is a blind signal separation. A band ICA was firstly proposed by Ulryc h etal [7] to solve blind de-convolution; then, the improved Fast ICA method proposed by LIU XI-wu et al [8]. The original coefficient reflection was estimated by introducing constraints in independent component analysis in the Bussgang algorithm adopted by YIN Xing-Yao et al [9].

Seismic data blind de-convolution is a blind process. Seismic wavelet excited by an explosion is unknown. Adjacent reflection seismic waves overlap in seismic record. Because the thickness of the strata is usually smaller than the wavelength of seismic waves, seismic wavelet can not be separated from seismic records. The process is similar to inter-symbol interference in communication. A seismic blind

equalization algorithm based on constant modulus algorithm was proposed to obtain seismic wavelet by equalization technology eliminating inter-symbol interference.

2 Problem Model

During the seismic wave propagation process underground, it was blocked by the ground and reflected to the surface. These waves were received by the sensor and formed seismic records. The formation of seismic records can be described as the convolution model, that is:

$$y(t) = \sum_{i=1}^{\infty} h_i x(t - \tau_i) + n(t) \tag{1}$$

Where, $y(t)$ is seismic record. $x(t)$ is seismic wavelet. $n(t)$ is noise. h_i is the reflection coefficient of the i th reflection surface. τ_i is the two-way travel time from the excitation point reflected by the ground the first one to the receiving point of the interface. Convolution model is widely used to describe the seismic signal.

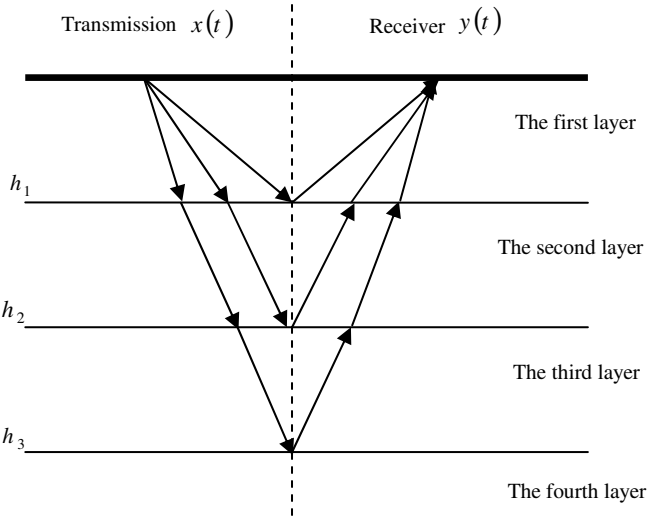

Fig. 1. The diagram of seismic signal transmission

Blind de-convolution approach utilizes seismic wavelet that extracted from seismic profile as an anti-de-convolution filter to complete operation. One of the most critical operations is wavelet extraction. That is, seismic wave $x(t)$ was estimated by seismic record $y(t)$. Blind equalization was utilized to realize estimating the seismic wavelet, and the transversal filter was used as the equalizer.

3 An Improved Clssical Blind Equalization in Seismic Signal Processing

Bussgang blind equalizer developed from the traditional adaptive equalization techniques. It is an important branch of the blind equalization technique, and processes many distinguishing features such as the lower complexity of computation, clear physical concepts and easy to implement and so on. Different Bussgang blind equalizer selects different non-memory nonlinear function. The principle was shown in Figure 2.

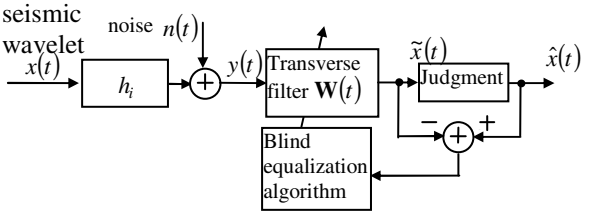

Fig. 2. Principle block diagram of blind equalization algorithm in seismic signal processing

In the figure 2, h_i is the reflection coefficient; $\mathrm{n}(t)$ is additive Gaussian noise; $\mathbf{W}(t)=[w_1(t),w_2(t),\cdots,w_N(t)]$ is the weight of transversal filter. Supposing $\tilde{x}(t)$ is the output of the equalizer. Then, $\tilde{x}(t)$ passes a memory-less nonlinear function. A rough estimate of the original signal was obtained. Then, the error between the estimated and the output was utilized by mean square (LMS) algorithm to adjust $\mathbf{W}(t)$, and the operation makes $\hat{x}(t)$ approach $x(t)$. Adjustment is not stopped until the algorithm convergences.

The cost function is

$$J(t)=E\left[\left(\tilde{y}^2(t)-R_2\right)^2\right] \tag{2}$$

Where, R_2 depends on fourth-order statistics of one-dimensional signal sequence formed by two-dimensional image. When statistical information of the image is known, R_2 is a constant.

In practice, the expectation value of variable can not been calculated. The instantaneous value of the solution often was utilized to replace the statistical average value. The above equation can be transform into,

$$J(t)=\left[\tilde{f}^2(t)-R_2\right]^2 \tag{3}$$

LMS algorithm was utilized to solve the cost function. As $J(t)$ is essentially a function of $w_r(t)$, then

$$w_r(t+1)=w_r(t)-\mu\frac{\partial J(t)}{\partial w_r(t)}\quad r=0,1,\cdots,L-1 \tag{4}$$

Where, μ is the step size factor.

From equation (10)

$$\begin{aligned}\frac{\partial J(t)}{\partial w_r(\mathrm{t})} &= \left[\tilde{x}^2(\mathrm{t}) - R_2\right]\tilde{x}(\mathrm{t})\frac{\partial \tilde{x}(\mathrm{t})}{\partial w_r(\mathrm{t})} \\ &= \left[\tilde{x}^2(\mathrm{t}) - R_2\right]\tilde{x}(\mathrm{t})y(\mathrm{t}-r)\end{aligned} \tag{5}$$

Iterative weight vector can be described by the vector form as following.

$$\mathbf{W}(t+1) = \mathbf{W}(t) - \mu\left[\tilde{x}^2(t) - R_2\right]\tilde{x}(t)\mathbf{y}(t) \tag{6}$$

The shortcoming of the traditional constant modulus algorithm is slow convergence. In order to improve the performance of the algorithm, this article introduced the second derivative matrix of a fractional lower order formula constant modulus cost function to the updating weight vector. It made the error performance surface of the cost function be better approximate, so that the convergence rate can be improved [9]. The weight vector update formula of new algorithm is

$$\mathbf{W}(t+1) = \mathbf{W}(t) - \mu\boldsymbol{\Theta}^{-1}(t)\left[\tilde{x}^2(t) - R_2\right]\tilde{x}(t)\mathbf{y}(t) \tag{7}$$

Where, $\boldsymbol{\Theta}(t)$ is a positive definite Hessian matrix. The form is

$$\boldsymbol{\Theta}(t) = 2\mathrm{E}\left[2|\tilde{x}(t)|^2 - R_2\right]\mathbf{y}(t)\mathbf{y}^{\mathrm{T}}(t) \tag{8}$$

Usually, the expected value of the solution is used to replace the statistical average of the average. Then equation (14) becomes

$$\hat{\boldsymbol{\Theta}}(t) = 2\frac{1-\lambda}{1-\lambda^n}\sum_{l=1}^{n}\lambda^{n-l}\left[2|\tilde{x}(t)|^2 - R_2\right]\mathbf{y}(t)\mathbf{y}^{\mathrm{T}}(t) \tag{9}$$

Where, the forgetting factor $\lambda \in (0,1)$.

In order to simply analyze, supposing

$$\mathbf{P}(t) = \sum_{l=1}^{n}\lambda^{n-l}\left[2|\tilde{x}(t)|^2 - R_2\right]\mathbf{y}(t)\mathbf{y}^{\mathrm{T}}(t) \tag{10}$$

$$\mathbf{Q}(t) = \mathbf{P}^{-1}(t) \tag{11}$$

Then

$$\hat{\boldsymbol{\Theta}}^{-1}(t) = \frac{1-\lambda^n}{2(1-\lambda)}\mathbf{P}^{-1}(t) = \frac{1-\lambda^n}{2(1-\lambda)}\mathbf{Q}(t) \tag{12}$$

$$\mathbf{P}(t) = \lambda\mathbf{P}(t-1) + \left[2|\tilde{x}(t)|^2 - R_2\right]\mathbf{y}(t)\mathbf{y}^{\mathrm{T}}(t) \tag{13}$$

Using matrix inversion principle can be obtained

$$\begin{aligned}\mathbf{Q}(t) = &\frac{1}{\lambda}\mathbf{Q}(t-1) - \\ &\frac{\lambda^{-2}\mathbf{Q}(t-1)\mathbf{y}(t)\mathbf{y}^{\mathrm{T}}(t)\mathbf{Q}(t-1)}{\left[2|\tilde{x}(t)|^2 - R_2\right] + \lambda^{-1}\mathbf{y}^{\mathrm{T}}(t)\mathbf{Q}(t-1)\mathbf{y}(t)}\end{aligned} \tag{14}$$

The new iteration formula is

$$\mathbf{W}(t+1) = \mathbf{W}(t) - \mu \frac{1-\lambda^n}{1-\lambda} \left[\tilde{x}^2(t) - R_2\right] \tilde{x}(t) \mathbf{Q}(t) \mathbf{y}(t) \tag{15}$$

We can get the global convergence optimal solution of seismic waves by iterative equation (15).

4 Simulation

In order to validate the algorithm, simulation experiment utilizes the horizontal layered model, chooses 50 Hz for non-minimum phase wavelet. The reflection coefficient is the simulated data. In order to test whether the algorithm is sensitive to noise, random noise was added in the synthetic seismic sections, the SNR between the reflected wave and random noise is 30 dB. Figure 3 is a simulation of the non-minimum phase wavelet. Figure 4 synthetic seismic trace. Figure 5 is the original reflection coefficient. Figure 6 is the reflection coefficient obtained by the conventional constant modulus algorithm. Figure 7 is the reflection coefficient obtained by the modified constant modulus algorithm. Compare Figures 6 and 7, we can see that the result of improved constant modulus algorithm is more consistent with the original reflection coefficient. It indicates that this method has better stability, not sensitive to noise.

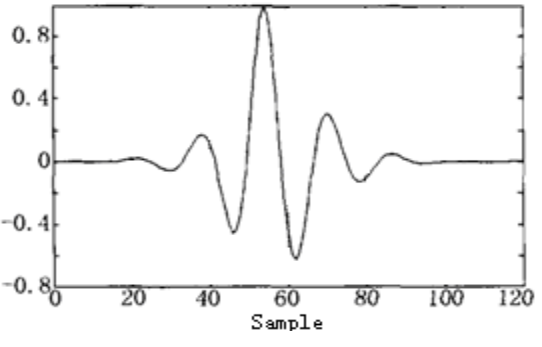

Fig. 3. The non-minimum phase wavelet

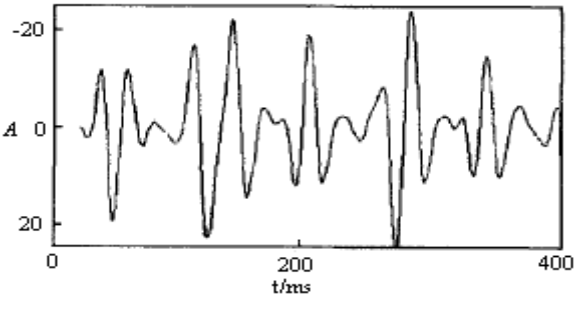

Fig. 4. Synthetic seismic

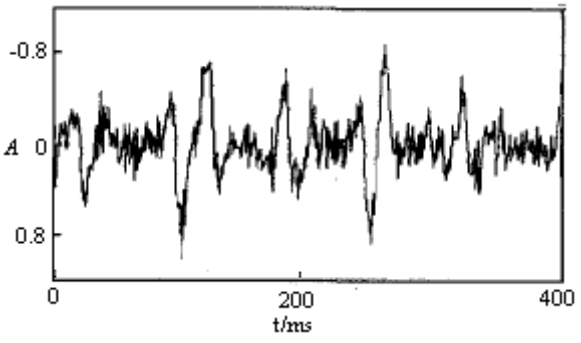

Fig. 5. The original reflection coefficient

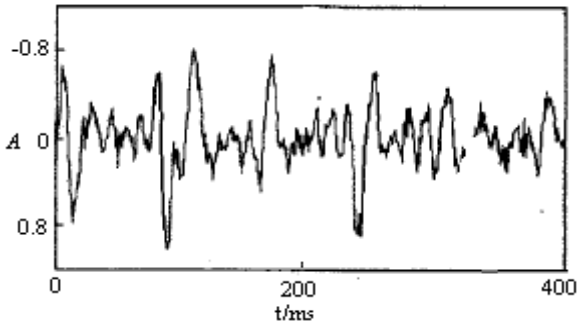

Fig. 6. The reflection coefficient obtained by the conventional constant modulus algorithm

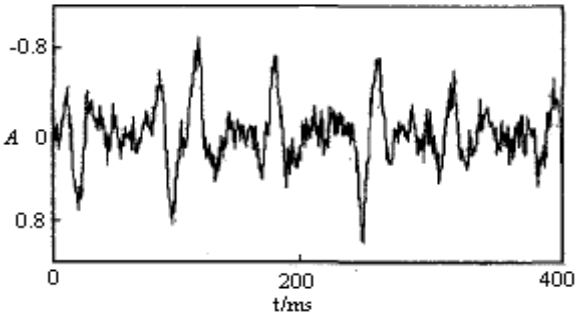

Fig. 7. The reflection coefficient obtained by the modified constant modulus algorithm

5 Conclusion

Seismic blind de-convolution, as a effective method to improve the capacity of distinguish seismic data, can broaden the bandwidth of seismic records, stand out the micro-structure information. It possesses high value and prospects in the seismic signal processing applications. Blind equalization algorithm in communication was

applied to seismic signal detection in this paper. The constant modulus blind equalization cost function applied to seismic signal was founded. The new cost function was iteratively solved by LMS algorithm. In order to overcome the defect of the constant modulus algorithm, slow convergence, the update of the weight vector was completed by introducing the second order Hessian matrix of cost function. The convergence rate was speeded up, and the performance of constant modulus algorithm was improved. Theoretical and practical data processing show that the method can better adapt to non-minimum phase systems. The optimal reflection coefficient can be obtained. The algorithm is stable, possesses fast convergence, high precision, and easily is applied.

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Evaluation of the Enterprise Safety Climate Based on Factor Restructuring Analysis

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Abstract. Considering that the current evaluation methods for enterprise safety climate are relatively simple and subjective, an enterprise safety climate index system, which consists of enterprise decision-making level, management level, and implementation level, is constructed based on the principle of SMART. Then, a corresponding enterprise safety climate evaluation model adapting to the characteristics of this index system is presented with consideration of the constraint condition of data and by taking full use of the advantages of factor restructuring analysis and principal component analysis in data processing. An applied example demonstrates the feasibility and practicality of this model. The model provides an operable way for resolving the evaluation of enterprise safety climate with large and complex index system, small sample space and few historical data.

Keywords: enterprise safety climate, index system, factor system restructuring analysis, principal component analysis, evaluation model.

1 Introduction

As the rapid development of economy in our country, the enterprise safety plays a more important role gradually. It is critical to learn how to manufacture in safe climate and minimize the accident rate in manufactory. Enterprise safety climate, as a tool to appraise safety culture, can reflect the awareness of the staff about the safety in the enterprise. And it can also reflect the enterprise safety condition at a particular place in particular time [1]. Therefore it is significant to appraise the enterprise safety climate.

At present Chinese scholars has carried out many researches by use of factor restructuring analysis. Pengtao Wang and Xizhen Gao [2] used it to forecast the increase rate of the talents, quality of the talents and structure proportion of the talents for the programming of the talent development; Guangfu Shu [3] once used it to research the macro-economics, Liping Tang [4] used it to optimize and appraise the asset management; And Yunhai Liang [5] applied it to analyze the district selectivity of petroleum and social factors to the consumption of petroleum.

This article serves to clarify the complicated relation between the logic and mathematics of factors and indexes by virtue of the factor restructuring analysis. Based on its particular characteristic, the author applies the characteristic of the Enterprise

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Safety Climate Index System to appraise itself objectively and takes 10 chemical plants in X city as examples to do investigation.

2 Selecting of the Appraisal Method

The "Enterprise Safety Climate" research belongs to the "Psychology Preventative" research. It is a kind of awareness of enterprise safety state in a particular time. Research achievements are few in this field and there is no practical report to be used. As a result in the enterprise safety climate appraisal index system, usable historical datum is few, while qualitative indexes are numerous and the index system is colossal and complicated. Regarding to the above disadvantages, this article select the 'Principal Component Analysis' and 'Factor Restructuring Analysis' to appraise the index system.

Principal Component Analysis [6] aims at simplifying the mute-index to few integrated indexes, by use of dimension reduction's idea and mathematical transformation. It can also make the problems simple and intuitionist by transferring the high dimensional problem to low dimensional problem. Moreover these few integrated indexes are independent of each other and keep almost information from the original indexes.

Factor system Restructuring Analysis [7] aims to reflect the extent of the propinquity between the assumed system and the original system, by working out the nature function value of the assumed system, which consists of factors level and index level. The less the propinquity extent is, the more obvious the effect (relativity or resemblance) is; vice versa. Factor restructuring analysis offers a more simple and practical method to find major factors. It could not only show the major factor's or major factor group's level, but also sort order according to the weightiness of all factors' levels. In addition it can be worked out the quantitative value according to its importance. Hence this method can be made use of the integrated appraisal.

3 Establishment of Enterprise Safety Climate Appraisal Index System

3.1 Enterprise Safety Climate Appraisal Index System

In accordance with the "SMART" [8]principal to design the enterprise safety climate appraisal index system, the first level index is set up and combined with the internal work environment as a main body, which consists of "decision-making level", "management level" and "implementation level". Further take their priorities and different functions into consideration to establish the second level index and the third level index, which involved in microcosmic hierarchy, time and dimensionality and indirect impact from the staff's relations. Detailed index system is listed in Table 1 as follows:

Table 1. Index system of enterprise safety climate

First grade indexes	Second grade indexes	Third grade indexes	First grade indexes	Second grade indexes	Third grade indexes
Decision –making level (J)	Organizational guarantee	Security department safety	**Implementation level(Z)**	Risk identification	Found safety hidden trouble rate
		Organization support			Per-capita found safety hidden trouble rate
		Safety work clear			Awareness of safety risk
	System guarantee	Safety training ratio			The number of controlling emergency measure
		Safety meeting attendance rate			5 years, the trend of accident
		Safety work support		Qualification	The rate of certificate
		New machine security inspection rate			Safety training participation rate
	Capital guarantee	Safety production capital investment rate			Participation rate of safe operation
		Safety culture capital investment rate			The wear rate of safety
Management level(G)	Supervision	Suggest frequency			Safety performance of the self-assessment
		Correct ratio		Working pressure and climate	Working pressure rating
		Action ratio			Pressure release channel
		Data completeness			Communication environment
	Professional knowledge and communication	Safety qualification rate			Time rate of work safety
		Safety knowledge rich degree			
		Safety knowledge popularity			Members attention
		Safety suggest feedback rate			
		Safety communication rate			Members reminded rate
		Safety communication frequency			
	Learning and spreading	Safety activity number			Evaluation of security environment
		Safety training number			
		Result feedback ratio	**Working Environment(E)**	Equipment performance	
		Worker family training number		Safety equipment rate	
		Spreading safe information types		Wear proper safety equipment rate	
		Spreading safe information frequency		Field order	
		Spreading safe information machine number		Live comfortably	

3.2 Evaluation Model of Enterprise Safety Climate

Factor system restructuring analysis and Principal Component Analysis method used mainly in combination, principal component analysis simplified evaluation index, the use of the ideological dimension reduction, and eliminate duplication of indexes, At last , get a few composite indexes. Factor system reconstructing analysis is mainly qualitative indexes of safety climate more and less historical data available to the characteristics then integrate the index and will eventually come to the comprehensive evaluation value.

Concrete steps: according to Table 1set 43 three indexes, draw to the specific value as the raw data x_{ij} . Based on them, take quantitative analysis and evaluation.

1) Processing the raw data x_{ij} of 43 third grade indexes, it's according to formula (1) into the standard index value x_{ij}^{*} ;

$$x_{ij}^{*} = \frac{x_{ij} - \overline{x_{ij}}}{\sigma_{ij}^{2}} (i = 1,2,...,n;\ j = 1,2,...,m) \tag{1}$$

In the formula (1), $\overline{x_{ij}}$ and σ_{ij}^{2} are stand for the average and variance of the x_{ij}

2) Find x_{ij}^{*} standardized indexes of pairwise correlation coefficients, and get correlation coefficient matrix $R = (r_{ij})_{m \times m}$

$$r_{ij} = \frac{1}{n} \sum_{t=1}^{n} x_{ti} x_{tj} (i, j = 1,2,...,m) \tag{2}$$

3) Find the eigenvalues of the correlation matrix R, find the descending order according to the scheduled cumulative contribution rate $\sum_{i=1}^{n} \lambda_i / m$ (usually cumulative contribution rate of 85% or more is preferred). Determine the number $p(p \le m)$ of principal components and obtain corresponding to the contribution rate, the cumulative contribution rate and eigenvectors.

4) The extracted principal components re-integrate the index system, and according to the definite interval and level value to calculate the proximity of the each index to the level value.

$$\Phi_{k,i} = \frac{\Phi_k(T) - \min \Phi_{k,j}}{\max \Phi_{k,i} - \min \Phi_{k,i}} \tag{3}$$

$\Phi_{k,i}$ is the proximity of the T samples of the K index to the $\max \Phi_{k,i}$, $1 - \Phi_{k,i}$ is the proximity of the first K index to the $\min \Phi_{k,i}$, i stand for the i interval $(i = 1,2)$, $\Phi_k(T)$ is specific value of the T samples of the K index. $\max \Phi_{k,i}$ is the interval upper bound of the $\Phi_k(T)$, $\min \Phi_{k,i}$ is the interval lower of the $\Phi_k(T)$.

5) According to the proximity of the each index to the level value determine aggregation state function matrix.

6) Take the data in the aggregation state function matrix input the GENREC file analysis software, run the software and get the output. Obtain the importance sum value $f_i(i=1,2,3)$ in the three diffident levels by integrating index of safety climate.

7) Calculate the show degree $p_i(i=1,2,\cdots,3)$ of the level value at the final evaluation.

$$p_i = \frac{f_i - \min \Phi_j}{\max \Phi_i - \min \Phi_j}(i=1,2,3) \tag{4}$$

8) Calculate the final evaluation V of the enterprise safety climate.

$$V = \sum_{i=1}^{3} p_i e_i / \sum_{i=1}^{3} p_i (i=1,2,3) \tag{5}$$

In the formula (5), $p_i(i=1,2,\cdots,3)$ denotes the show degree of the level value in the final evaluation. $e_i(i=1,2,3)$ is the lower bound of the low level ， the median of the middle level that mean (middle level lower bound + middle level upper bound)/2, the upper bound of the high level.

4 Case Study

As the example of enterprise safety climate, select small and medium sized chemical companies with greater security risk as evaluation objects. For ten medium sized chemical companies in X city (A is the company which is to be evaluated), hiring professional security consultants and relevant safety regulators, conduct field observations, researches, interviews, questionnaires according to specific evaluation criteria of enterprise security environment index, come to the raw data about security environment index. On this basis, carry on evaluation as the following steps [1].

4.1 Extracting Principal Component to (J) Data of Sample Corporate Decision-Making Level

The raw data through questionnaires is shown as the following table

Table 2. The raw data of each index of decision-making level

NO.	J_{11}	J_{12}	J_{13}	J_{21}	J_{22}	J_{23}	J_{24}	J_{31}	J_{32}
1	4.3	4.6	4.2	0.97	0.93	0.96	0.97	0.12	0.06
2	5.4	5.5	5.6	0.99	0.98	0.97	0.98	0.1	0.04
3	3	2.9	3.2	0.78	0.86	0.46	0.9	0.01	0
4	2.6	1.9	1.3	0.7	0.62	0.49	0.6	0	0
5	3.1	3.4	3.2	0.7	0.85	0.32	0.84	0	0
6	4.6	4.3	4.2	0.94	0.95	0.96	0.95	0.08	0.02
7	2.9	1.7	1.8	0.78	0.74	0.84	0.81	0.02	0
8	3.1	2	1.9	0.72	0.72	0.63	0.78	0.02	0
9	3.2	2.8	3	0.84	0.87	0.73	0.86	0.02	0
A	5.6	5.4	5.5	0.98	0.99	0.96	0.96	0.06	0.01

Calculating the correlation matrix of standardized matrix

1.000	.944	.940	.915	.844	.768	.773	.804	.624
.944	1.000	.983	.876	.911	.603	.819	.793	.691
.940	.983	1.000	.880	.954	.608	.878	.747	.616
.915	.876	.880	1.000	.855	.885	.829	.906	.754
.844	.911	.954	.855	1.000	.587	.958	.710	.570
.768	.603	.608	.885	.587	1.000	.623	.837	.647
.773	.819	.878	.829	.958	.623	1.000	.741	.610
.804	.793	.747	.906	.710	.837	.741	1.000	.940
.624	.691	.616	.754	.570	.647	.610	.940	1.000

Calculating eigenvalues and eigenvectors of the correlation matrix

Table 3. Eigenvalues and the contribution rate and the accumulative contribution rate

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.348	81.642	81.642	7.348	81.642	81.642
2	.869	9.657	91.299	8.217	91.299	91.299
3	.432	4.805	96.105			
4	.289	3.216	99.321			
5	.041	.461	99.782			
6	.011	.125	99.907			
7	.007	.073	99.980			
8	.002	.018	99.997			
9	.000	.003	100.000			

Accumulative contribution rate of the first eigenvalue is more than 85%, so select the first two main components, and the corresponding eigenvector is:

0.3494	0.3487	0.3475	0.3595	0.3420	0.2995	0.3376	0.3248	0.2830
0.1217	0.1947	0.3081	0.0187	0.3506	-0.349	0.2292	-0.4787	-0.5739

Component values of decision-making level of each enterprise according to the eigenvectors and the standardized matrix.

Table 4. The principal component values of decision-making level of each enterprise

Enterprise	1	2	3	4	5	6	7	8	9	A
The first principal component value	3.3152	4.855	-1.635	-4.5198	-2.069	2.2866	-2.3975	-2.7782	-1.009	3.9514
The second principal component value	-2.0552	0.1712	1.1114	-0.8162	1.4146	-0.4266	-0.7714	-0.4396	0.4469	1.3649

The principal component extraction method of the three indexes of management, execution level and the working environment in the article is the same to above-mentioned decision-making level, and omit the calculation process because of being limited to the length of the article.

4.2 Follow the above Steps to Extract the Principal Component and Re-integrate Index System of Enterprise Safety Culture

Table 5. Integrated enterprise safety climate index system and the principal component values

NO.	The first Principal component of the J level	The second principal component of the J level	The first principal component of the G level	The second principal component of the G level	The third Principal Component of the G level	The first principal component of the Z level	The second principal component of the Z level	The third principal component of the Z level	E1	E2	E3	E4	E5
1	3.3152	-2.0552	5.96568	-1.10592	-0.80232	3.1763	4.2998	0.2534	3.8	0.96	0.66	4.7	3.4
2	4.855	0.1712	5.90628	-1.08588	1.65504	4.2675	-0.9183	0.0509	3.9	0.95	0.68	4.9	3.1
3	-1.635	1.1114	-2.7948	-0.53832	1.51464	-1.7786	-1.6669	0.4292	4.4	0.67	0.52	3.4	1.4
4	-4.5198	-0.8162	-3.35964	-2.28768	-1.11276	-0.3443	-0.1544	-0.0190	3.6	0.74	0.63	2.5	1.3
5	-2.069	1.4146	-2.32116	1.4226	0.44592	-2.5958	-3.2976	1.0680	3.6	0.62	0.80	3.9	1.6
6	2.2866	-0.4266	3.59616	1.29216	-1.20168	3.0196	2.4300	0.5617	3.1	0.99	0.91	4.5	3.9
7	-2.3975	-0.7714	-3.49236	0.24564	-0.8118	-2.9380	-0.5534	-0.3922	3.9	0.73	0.47	3.1	3.1
8	-2.7782	-0.4396	-4.95072	0.03204	-0.21912	-3.67378	2.9953	0.0645	3.8	0.93	0.82	3.9	3.7
9	-1.009	0.4469	-3.13056	0.75024	0.71244	-2.6897	1.1109	-1.5601	2.6	0.73	0.49	3.1	2.3
A	3.9514	1.3649	4.581	1.27524	-0.18048	4.6507	-3.6551	-0.8960	4.7	0.81	0.55	3.3	1.7

4.3 According to the Definite Interval and Level Value, Calculate the Proximity of the Each Index to the Level Value

4.4 According to the Proximity of the Each index to the Level Value Determine Aggregation State Function Matrix

2	1	2	1	1	2	2	2	2	2	2	2	2	0.53009
3	2	3	2	2	3	3	3	3	3	3	3	3	6.76511
2	2	2	1	1	1	2	2	1	2	2	2	2	1.63185
3	3	3	2	2	2	3	3	2	3	3	3	3	6.13789
1	2	1	1	1	1	2	2	1	2	1	1	1	4.11257
2	3	2	2	2	2	3	3	2	3	2	2	2	2.26083
1	1	1	1	1	1	1	1	1	1	1	2	1	7.68108
2	2	2	2	2	2	2	2	2	2	2	3	2	0.82313
1	2	2	2	2	1	1	1	2	1	1	2	2	5.97124

2	3	3	3	3	2	2	2	3	2	2	3	3	2	1.35586
2	1	2	2	2	1	2	1	2	1	2	2	2	2	2.27744
3	2	3	3	3	2	3	2	3	2	3	3	3	3	5.14668
1	1	2	2	2	2	1	2	1	2	1	1	1	2	5.60879
2	2	3	3	3	3	2	3	2	3	2	2	2	3	1.5906
1	1	2	2	2	1	1	1	1	1	1	1	1	1	5.23446
2	2	3	3	3	2	2	2	2	2	2	2	2	2	1.7853
1	2	2	2	2	2	1	2	1	2	1	1	1	1	4.61362
2	3	3	3	3	3	2	3	2	3	2	2	2	2	2.64066

4.5 Take Data in the Aggregation State Function Matrix Input the GENREC File Analysis Software Run the Software and Get the Output

Obtain the importance sum value $f_i(i=1,2,3)$ in the three diffident levels by integrating index of enterprise A safety climate.

$$f_1 = 1.57\text{E-}01 \qquad f_2 = 1.10\text{E-}01 \qquad f_3 = 1.28\text{E-}01$$

4.6 Calculate the Show Degree $p_i(i=1,2,\cdots,3)$ of the Level Value at the Final Evaluation

$$p_1 = 3.59\text{E-}01 \qquad p_2 = 5.42\text{E-}01 \qquad p_3 = 6.15\text{E-}01$$

4.7 Calculate the Final Evaluation V of the Enterprise Safety Climate

$$V = \frac{P_1 \times 0.02 + P_2 \times 0.6 + P_3 \times 1}{P_1 + P_2 + P_3} = 0.6249$$

In accordance with enterprises safety climate assessment level [1], $V \in [0.55,0.7)$, climate safety of A enterprises is the third level, the current status of enterprises safety climate in general. The current enterprises safety climate should be improved from safeguards on safety in decision-making and production safety supervision, staff's risk awareness and work competence in management. It should do some basic work to comprehensively improve the safety climate by creating a good safety climate of an enterprise as soon as possible by enhancing all staffs' training and learning and improving working environment within the enterprise.

5 Conclusion

Based on the above research, the author's main ideas and research results can be summarized as follows:

Make full use of the advantage of the principal component analysis and factors restructuring analysis in filtering the data noise, preserving and highlighting the raw data, processing the complex, vague and uncertain relationship between the indexes, as well as applying to the small space sample, and other areas. The evaluation model

of enterprise safety culture is built which apply to the characteristic of index system and consider the data constraints.

Based on the theoretical analysis, aim at the X city of 10 chemical production enterprises in accordance with index system and evaluation guidelines for raw data collection, the use of safety culture evaluation for empirical analysis, obtain the A final result of safety culture .According to the evaluation criteria for the classification level of the evaluation results were analyzed to verify the enterprise safety culture evaluation model availability and operability based on factor system restructuring analysis and principal component analysis.

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Research on the Methods of Risk Evaluation in Progress Goal Programming of Expressway Construction Project

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Abstract. In view of the phenomenon that there are not so many measures of risk evaluation in progress goal programming of expressway construction project, this paper defined the contents of risk evaluation in progress goal programming of expressway construction project, and then established a model of progress goal programming of expressway construction project by analyzing the advantages, disadvantages and applicability of risk evaluation measures in present phase and summarizing combined measures of risk evaluation in progress goal programming of expressway construction project based on risk management theory by the application in progress goal programming of expressway construction project in the hope to provide new ideas for effective management of expressway project construction Progress.

Keywords: expressway project, goal programming of construction project, risk management theory, combined risk evaluation.

1 Introduction

In order to solve the frequency issue of delayed construction schedule in expressway construction project progress, many scholars have usefully researched some measures of risk evaluation. Qingjun Guo, Yunxiu Sai [1] and Yuliang Zou [2] have used comparative analysis to establish optimization model of objective function for the issue that it is hard to achieve schedule, quality and cost at the same time. Linlin Xie and Hongyuan Fu [3] have proposed a risk evaluation measure based on analysis of the gray for the rule that decision risks of government investment are different from the general risk of project decision-making based on various steps, method and application of risk analysis. Nevertheless, there are not so many measures of risk evaluation in progress goal programming of expressway construction project, which draws the conclusion that it is necessary to contrast and analyze an effective measure about risk evaluation in progress goal programming of expressway construction project.

2 The Risk Assessment Contents of Goal Programming in the Construction Schedule of Express Expressway Projects

At present, the definitions of the risk assessment contents of goal programming in the construction schedule of express expressway projects at home and abroad have been mainly studied from time perspective to factors affecting perspective [4].

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2.1 The Risk Assessment of Goal Programming in the Construction Schedule of Express Expressway Projects in Time Perspective

From the view of time perspective, the risk assessment of goal programming in the construction schedule of express expressway projects should include prior evaluation, course evaluation, afterwards evaluation and follow-up assessment. There are many differences among the basic data, the conditions, the contents of assessment etc, which is used in the process of risk assessment. In the previous of the risk assessment of goal programming in the construction schedule of expressway projects, while some risk-assessment methods have been applied by some scholars in other areas With regard to the problem of the current transport ships rating method was too simple rough, the method of AHP which can combine the qualitative analysis and quantitative analysis has been applied in the afterwards evaluation of ship engineering projects by Yonghui Zhang, Yan Lin, Zhuoshang Ji[5]. They used AHP to deal with the case calculation after elaborating principle of AHP. Yun Liang, Shuping Yi and Shiquan Xiong [6] have evaluated the enterprise in advance by using fuzzy comprehensive evaluation method in the perspective of corporate performance.

The relationships among the prior evaluation, course evaluation, afterwards evaluation and tracking evaluation are shown in Figure 1.

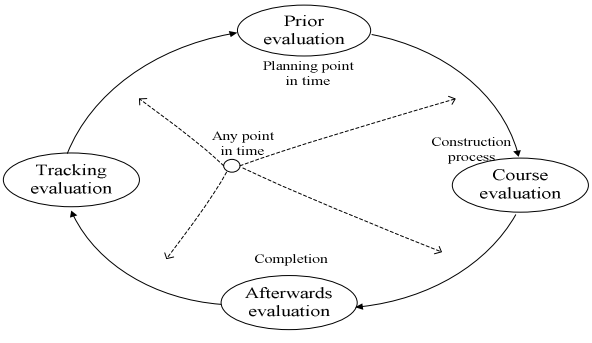

Fig. 1. The risk assessment contents of goal programming in the construction schedule of express expressway projects in time perspective

2.2 The Risk Assessment of Goal Programming in the Construction Schedule of Express Expressway Projects in Factors Affecting Perspective

In the Expressway construction projects, there exist two main risks, which is also known as the constraint conditions divided into hard constraint conditions and soft constraint conditions. M. Shelbourn, N.M. Bouchlaghem, C. Anumba and P. Carrillo [7] have the same opinions in the literatures about the project planning and effective implementation. Hard constraint conditions include quality risk constraints and safety risk constraints. Soft constraint conditions include cost risk constraints and earnings risk constraints.

- Quality Risk Constraints

As a measure to evaluate success of the project, quality objective has comprehensive quality plans and control measures in the management of goal programming in the construction schedule of express expressway projects. Therefore, it can not only ensure the intended function and quality requirements of the project, but also play an important role in guaranteeing the speed of construction progress. What's more, rework costs in the implementation process and the maintenance costs after putting into use would be reduced certainly. According to the index system of the project quality risk, Guosheng Huang[9], Xiangbo He[10] have constructed Fuzzy comprehensive evaluation model by using Fuzzy Comprehensive Evaluation for the problem of the construction project's quality risk.

- Safety Risk Constraints

Production safety is an indispensable part of the work of construction units in the expressway projects' implementation process. In construction process, safety is the speed, and the progress is ensured by safety. Therefore, we should study the best way that safety and progress can be compatible. As for the problem of the risk of the construction projects' safety, Yikun Su, Liqiang Song, Xiaodong Ma[11] have constructed a reasonable evaluation index system of construction production and safety management, and have scientifically analyzed the risk management of construction production and safety by using Fuzzy Comprehensive Evaluation.

- Cost Risk Constraints

When study the risk evaluation of Expressway project cost targets, we mainly estimate and evaluate the degree of deviation of project cost targets caused by risk sources in the construction process, principally considering the risk sources of the factors of construction compensation, such as design alteration, inflation of prices, fluctuations in exchange, force majeure and so on. According to experiences determined by the current cost of the project, Yuanfang Xie, Shen Wei and Meng Ling [12] have firstly analyzed the risk factors that influence project's objectives and constructed the model of fuzzy AHP, which combines fuzzy math with AHP in order to evaluate the risk factors of project's objectives.

- Earnings Risk Constraints

Earnings target of the expressway project is an important and determinant factor for ensuring the schedule target. In fact, in the schedule-management practice of the project, construction enterprises often need to estimate the value of target duration by the expected target income.

The relationship of the four objectives and schedule target is shown as Figure 2.

Among them, the core is the schedule objective; the root is quality and safety goal; the key is cost and earnings target. Normally, it is necessary to increase the cost and reduce the benefit if we intend to speed up the process and shorten the construction period. When the process is speeded, the quality and safety goal may be affected. While if we strictly control the quality and safety standards, the schedule objectives would be influenced actively. Then the cost can be reduced and the benefits can be increased. Only the four-risk constraints can we insure the construction schedule objectives of the expressway project to complete successfully. Therefore, it is an important method for the target-risk control of the construction schedule of the expressway project to study the risk evaluation of the four objectives' influential constraints.

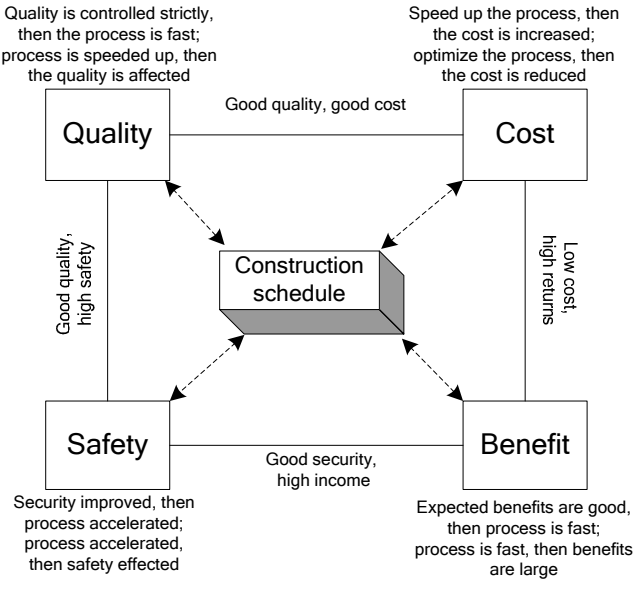
Quality is controlled strictly, then the process is fast; process is speeded up, then the quality is affected
Speed up the process, then the cost is increased; optimize the process, then the cost is reduced
Quality
Good quality, good cost
Cost
Good quality, high safety
Construction schedule
Low cost, high returns
Safety
Good security, high income
Benefit
Security improved, then process accelerated; process accelerated, then safety effected
Expected benefits are good, then process is fast; process is fast, then benefits are large

Fig. 2. The relationship of the four objectives and expressway project's schedule target

3 The Risk Assessment Theoretical Basis of Goal Programming in the Construction Schedule of Express Expressway Projects

Goal programming and risk management are interdependent in the construction schedule of express expressway projects; the risk management theories provide foundation and the planning scheme. As a subsystem of the expressway project, the goal of the schedule management and that of the other areas of knowledge management is the same, which is in order to achieve the minimum risk loss of their respective objectives. Then we can ensure the achievement of the overall objective of project. Therefore, the progress management of the expressway project must be executed under the "strategic" guidelines of the risk management theory. During the period of the expressway project's whole life cycle, the risk management and the schedule objectives management interact not only with each other, but also with the process of other knowledge areas.

4 Risk Evaluation in Progress Goal Programming of Expressway Construction Project

4.1 Analysis of Risk Evaluation Method

At present, main method of risk evaluation in china and abroad can be divided into qualitative analysis of evaluation, quantitative analysis of evaluation and combine

both of them. Qualitative method mainly the Delphi method, the comparative method, risk figure, project hypothesis testing and direct synthesis of qualitative risk assessment, etc. Quantitative method includes the sensitivity analysis, decision tree analysis method, the analytic hierarchy process (AHP), principal component analysis, and multi-level fuzzy comprehensive evaluation method, Monte Carlo simulation method etc.

The paper summarized the principle, advantages, disadvantages and applicability of combination of evaluation methods in table 1 below, in order to choose suitable methods for risk evaluation in progress goal programming of expressway construction project.

Table 1. Comparative analysis of risk assessment methods

NO.	Methods	Principles	Advantages	Disadvantages	Applicability
1	Expert evaluating method	Expert evaluation method is the ways to make quantitative evaluation score based on qualitative and quantitative analysis	requirement to statistical data and the original material is lower, simple	By the evaluators subjective influence	System of more precise and lower accuracy
2	Satisfaction degree formula	According to lots of index analysis and calculation results prescribing rating (satisfaction degree)	Realize the combination of qualitative and quantitative analysis	Satisfaction and overall satisfaction actual meanings are not clear	Get half trapezoid distribution functions.
3	Fuzzy comprehensive evaluation	Using the fuzzy relation synthesis principle to make quantitative evaluation on factors	Good at solving problems uncertainty and fuzziness.	Membership functions of determination and methods are not perfect	Fuzzy system comprehensive evaluation.
4	Gray evaluation	It realize the system operation behavior through extracting useful information	Solving accurate quantitative and statistical problems;	Need to determine the resolution. Selection criteria is unstandard.	Fuzzy system comprehensive evaluation.

Table 1. (*continued*)

5	Principal component analysis	It is a kind of important statistical method that turn multi-index problem into less comprehensive index	Simplified the variable system of statistics characteristics	Difficult to control data collection process of data correlation.	Index information is overlaps and huge.
6	Data envelopment analysis	Confirm effective production frontier, and confirm whether the decision-making units are effective according the distance status.	Have superiority in aspects about its simplify operations and reducing error issues.	Do not allow input/output data to be random variables.	Evaluation input and output of object system
7	Analytic hierarchy process	The system analysis method of qualitative analysis and quantitative analysis to solve the problems of layered serration.	Have convenient, quick and scientific characteristics.	It is hard to guarantee the weight inspection requirements	Quantitative method analysis of complex problems
8	GLPS	Mathematical modeling and demoting process that construct target function combined with practical problems based on real logical.	Can move the constraint of rightside item to pursue the targe.	Target function and constraints etc need to be amended many times	It is hard to optimize several targets at the same time
9	Monte Carlo simulation method	Obtain project target of probability distribution, expectations, variance, and standard deviation through multiple sampling calculation.	Relatively accurate, and it is intuitive and easy by the form of probabilistic diagram.	Need enough samples, the calculating process and repeatability is strong, and workload is big.	Often used in investment project risk analysis, and samples collection is more easy.

Qualitative and quantitative methods are commonly used on the risk evaluation through in-depth analysis of the advantages and disadvantages of the risk assessment method and wide applicability. This is because risk assessment is complicated system engineering, it is difficult to determine some attribute or not easily quantified evaluation factors, and even the evaluation factors itself, so it is difficult to achieve the ideal evaluation result. Then which can be qualitative and quantitative evaluated or both by personnel who has special knowledge or experience on evaluation objects. Moreover, with the development of computer technology, evaluation method is more and more abundant; the qualitative and quantitative combined risk evaluation method is often used in system evaluation.

4.2 The Applications about Combination of Evaluation Methods in Progress Goal Programming of Expressway Construction Project

Different projects should choose and combine the methods above based on the specific contents, features and conditions of project in the risk assessment method. For features and conditions of risk evaluation index system in progress goal programming of expressway construction project, the paper constructed the goal programming model based on the following two point principal component analysis evaluation method and object planning combinations, As is shown below:

- In order to solve the issue that there is a huge index system in progress goal programming of expressway construction project or information may overlap, this paper chose the method of principal component analysis to integrate each index, eliminated the part of information overlaps, strengthened and highlighted the key index, thus made the index system more concise, reflected the expressway construction progress target constraint conditions of information.
- For the issue that there are lots of risk evaluation contents in progress goal programming of expressway construction project, this paper combined method of goal programming and optimum choice of multi-objective, founded goal programming model after the processing of principal component analysis [4]. As shown in Figure 3.

This model is not only properly integrating the huge multifarious index system in order to reflect the overlap and key information, but also meet the constraint conditions in expressway construction progress goal programming in China currently. Moreover, it can simplify evaluation by the corresponding calculation software and can obtain the ideal evaluation results in actual application area.

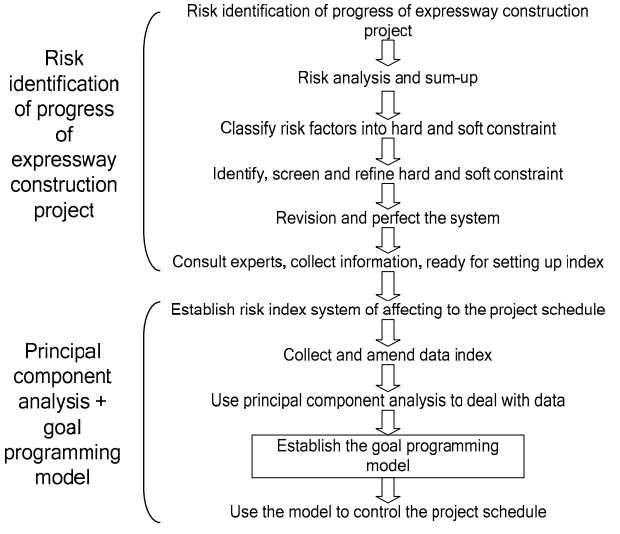
Risk identification of progress of expressway construction project
Risk analysis and sum-up
Classify risk factors into hard and soft constraint
Identify, screen and refine hard and soft constraint
Revision and perfect the system
Consult experts, collect information, ready for setting up index
Risk identification of progress of expressway construction project
Establish risk index system of affecting to the project schedule
Collect and amend data index
Use principal component analysis to deal with data
Establish the goal programming model
Use the model to control the project schedule
Principal component analysis + goal programming model

Fig. 3. Progress goal programming model of expressway construction project

5 Conclusion

This paper defined the contents of risk evaluation in progress goal programming of expressway construction project, and then established a model of progress goal programming of expressway construction project by analyzing the advantages, disadvantages and applicability of risk evaluation measures in present phase and summarizing combined measures of risk evaluation in progress goal programming of expressway construction project based on risk management theory. Moreover, the paper used this theory to build progress goal programming model of expressway construction project based on method of principal component analysis and goal programming in the hope to provide an extensibility research way for risk evaluation in effective management of expressway project construction Progress.

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Research on Systematic Definition of Goal Programming of Highway Construction Progress

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Abstract. The highway projects have many problems, such as numerous construction participants, multitudinous influential factors and complex goal programming system of construction progress. In order to provide more effective management for construction schedule targets of the highway project, this paper divides the goal programming system of highway project with systematic theory and risk management theory. After that, the paper carried on detailed identification about the inner system in five dimension-research angle ,planning content, planning point, target and factors. Based on this, the paper not only gets the content but also draws the diagram of the goal programming system of highway project schedule.

Keywords: goal programming of construction progress, internal system, external system, systematic theory, risk management theory, highway project.

1 Introduction

Project management planning and control are the results of the planning process, focusing on project scope, technology, risk and cost in all its aspects. In recent years, many scholars have carried on the beneficial explorations in the field of project schedule planning. Steyn H [1][2] considers the constraints of project management, explores the schedule planning method by using of critical chain method and has some theoretical groundwork role. Yuliang Zou [3] applies of mathematical programming for multiple targets in the construction management plan, constructs a unified objective functions through mathematical modeling, and promotes scientific and construction management. Xuean Liang [4] proposes to use the goal programming model to solve investment projects objective decision analysis, aiming at the existing problems and defects of investment construction projects decision-making process, and proves the rationality and validity of the method through the concrete example analysis. We find that study in the progress management of highway projects is still limited to methods and models of planning and controlling through reviewing literatures. The existing literatures lack detail station and specific scientific defined on the concept of goal programming, content and study of the scope, and only some literatures broadly mentioned the highway project schedule planning roughly content. The actual work also did not mention progress goal programming research to the management agenda, which largely affects progress

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management information feedback, make corrections and coordination of monitoring functions into full play. This paper defines concept, content and scope of the study of highway project progress goal programming, based on the project goal meaning and comprehensive consideration of the features of the highway project.

2 Define Concept of Highway Project Construction Schedule Goal Programming

From the perspective of management, planning is advanced deployment and arrangement the managers make in order to achieve the desired objectives within a certain period of time and space from the objective things and phenomena on the development of the future, and is a predicted change science [5].

Project planning is for predicting the future, determining the desired goals, estimating problems, proposing the goal, solving the problem of effective scheme, the policy measures and methods, but also consider how to allocate time, money and resources in the process after project feasibility study results show that project feasible or already have a condition.

With project planning and comprehensive consideration of the meaning of highway project and highway project is a complicated system. This paper defines highway project progress goal programming. Progress goal programming highway project is a systematic blueprint for the timing of project progress in clear highway project target premise and based on the work breakdown structure, which can be said that highway project is expected to start and finish time and can also: (1) Ensure timely and profitable to compensate for expenses that have occurred; (2) Coordinate resources so that resources can be used when needed; (3) Forecast and give priority to the money and resources needed for the project of different level in different time; (4) Meet the strict time limits for completion.

3 Divide Highway Project Construction Schedule Goal Programming System

Highway construction project is a complex systems engineering which involves substantial investment, wide space and long construction cycle. From planning to completion highway project experiences many links the organic link, besides construction project owners outside, usually includes engineering consultation, engineering survey and design, engineering supervision, equipment and material supply, engineering construction participants, and other participants are including Banks and insurance, and other financial institutions and government administrative supervision. The owner, designer, constructor and the supplier are the project's main construction units[6].

From the perspective of project participants, highway project participants is numerous, may be the perspective of the owner, the contractor and the suppliers; from the system point of view, as if the highway project planning is a system, then the highway project progress goal programming is a subsystem under highway project planning; from the temporal dimension point of view, that is, considering the whole

process of construction of highway projects, highway construction progress of the project objective of planning should be a feasibility study to the time period before the project started. Due to the complexity of the highway project, there is a need to define specific scope from planning studies, planning content, planning point, target dimensions and factors.

System theory is studying the general rules and properties of reality system or possible system. The so-called system is organic whole composed of several interrelated elements, composed of interacting with a specific function and certain purpose of its development. This definition shows that the composition of the system consists of three indispensable requirements: first, the system must be more than two elements; Second, elements and elements, elements and the whole, between the whole and the environment, there is a contact interaction; Third, the whole system has a definite functions [7].

By systematic theory as guidance can turn highway project construction schedule goal programming range into two systems, namely the internal system and external system of highway project construction schedule goal programming, in this paper, internal system involves planning studies, planning content, planning point, target dimensions and factors, and other factors are involved in the ranks of external system. The internal system is relatively intuitively expectations from the multi-perspective survey plan object, and the system is a development-oriented and requires a comprehensive perspective consideration of multi-build system. The internal system and external system of highway project construction schedule goal programming are interconnected and interacted systems, and the internal system is is included in the external system. Therefore, it is necessary to consider the impact of factors within the system, but also take into account the uncertainty of the external system, in the design of highway project construction schedule goal programming system. This paper mainly studies the internal system of highway project construction schedule goal programming.

4 Define Internal System of Highway Project Construction Schedule Goal Programming

4.1 The Study Angle of Highway Project Construction Schedule Goal Programming

The characteristics of highway projects determine project completion need multi-level participation and cooperation. As project participants are of the different nature of work units, tasks and interests and also of the different project management objectives, tasks and requirements. The project owner is the total integration and the overall organizer of the resource production. Supervision, cost, bidding agents and other units are on behalf of the interests of owners, and provide consulting services of full range and whole process.

According to the literature survey analysis showed that the management theory of the progress of highway projects in the researches have been put on the agenda, but from the perspective of planning and management, the implementation of highway projects management planning has not really implemented for many years. There are

many reasons, for example: the scope and depth in theory and in practice have no uniform requirement, so highway project owner's project management has been the lack of management planning.

The existing literature shows that project management planning majority is aimed at construction units and compilation [9], and owner square project management is a core of management. Therefore, reinforcing owners square project management planning is China's current form shall be addressed issues, this paper studies highway project progress goal programming that is standing in the owner angle at the comprehensive analysis.

4.2 The Research Object of Highway Project Construction Schedule Goal Programming

The highway project construction schedule goal programming is an important part of highway project planning and a subdirectory of the project goal planning, in the system view, namely subsystem. This subsystem can also contain a lot of second-level sub-headings, reflecting the level of the system. Highway construction projects involving the multi-objective is a complex systematic engineering, schedule control is good or bad, which is not only related to highway project construction period can be achieved, but also affect its quality and cost control. Highway project goals include schedule goals, quality, safety and cost and revenue goal, according to the division of highway projects. Highway project planning system-level logical structure of target is shown as follows:

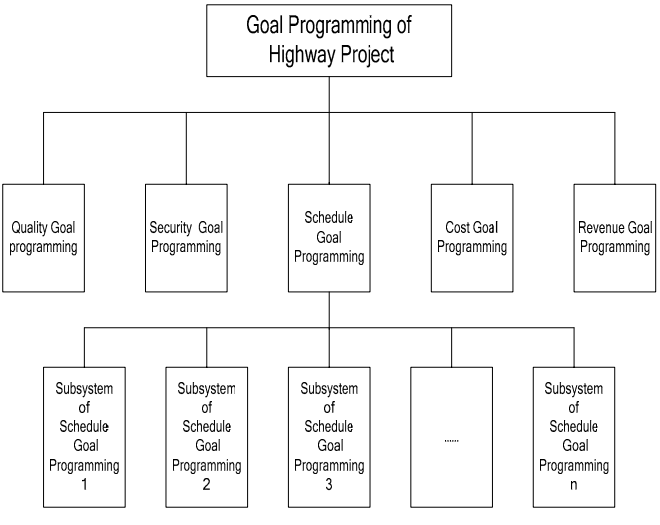
Goal Programming of Highway Project
Quality Goal programming
Security Goal Programming
Schedule Goal Programming
Cost Goal Programming
Revenue Goal Programming
Subsystem of Schedule Goal Programming 1
Subsystem of Schedule Goal Programming 2
Subsystem of Schedule Goal Programming 3
.....
Subsystem of Schedule Goal Programming n

Fig. 1. Highway project planning system-level logical structure of target

4.3 The Time Point of Highway Project Construction Schedule Goal Programming

For highway project construction schedule planning involves all phases of highway project construction, the need for planning conduct point definition. According to project stage division of project Life cycle theory[10],this paper specifically define highway project construction schedule goal programming points: highway project construction schedule objectives in project planning stage is after selected, project, feasibility, before the start of the project implementation, which is shown as follows:

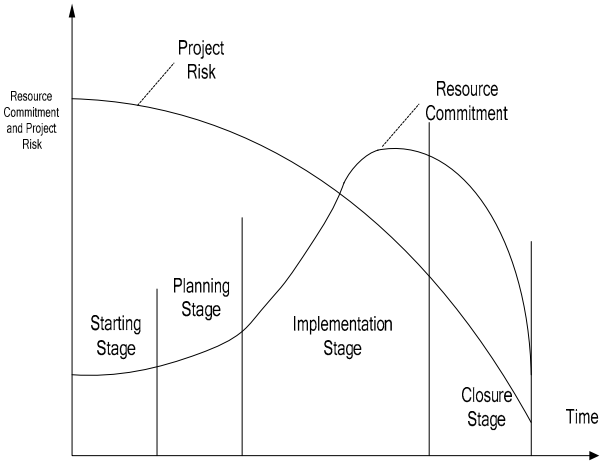

Fig. 2. Four stages of life cycle of highway project

The length of time of Highway project planning stage is related to the project scale, project investment size, complexity, the scope of project and so on. We can see from the above graph, resource inputs gradually increases with the passage of time, until the peak of the implementation stage. And another hidden factor - the risk factors are gradually reduced. There is also worthy of note, with the highway project on research and careful planning, the likelihood of success gradually increases; therefore, the project manager's control is weakened.

It can be learned, highway project advance work on the role of total project life cycle is vital, similarly function of highway project construction schedule goal programming can get a glimpse.

4.4 The Target Dimensions of Highway Project Construction Schedule Goal Programming

The goal of highway project construction schedule goal programming is defined as schedule goal, quality goal, security goal, cost goal, revenue goal. In highway project construction schedule goal programming, although schedule goal is as the first priority, but the other four goals for highway projects are also needed to try to meet and optimize, so that the project total goal can realize.

This dimension also can be defined from the systematic theory, in the overall goal of the highway project planning system, all subsystems are required to try to keep the order of priority as possible reasonably optimized combination and the final result is through the whole system of optimal to reflect. At this point, the highway project construction schedule planning system is the subsystem of the project objectives planning system.

4.5 The Factors of Highway Project Construction Schedule Goal Programming

Highway project is a complex system, involving many factors, so it is necessary to define the factors of highway project construction schedule planning.

Firstly, from the angle of risk, the factors of the schedule objectives of highway construction progress can be divided into a variety of factors, someone's factors, physical factors, environmental factors and so on. Factors of highway project schedule risk include quality risk, security risk, cost risk and revenue risk[11].These risks are likely to pose a threat to project goal if are not managed and controlled, so increasing factors is better for identifying and analyzing the influential factors of each subsystem target.

Secondly, from the angle of systematic theory, highway project construction schedule goal programming is subsystems to project goal programming system; according to the risk management theory, we can see as far as possible the precondition of the subsystem optimization is minimal risk of a subsystem. Highway project's subsystems are formed respective factors dimension, thus factors' subsystems form factors of large system. This process is recessive and invisible and if not reasonably controlled, the final results may be reflected through dominant and visible risks.

Therefore, the main purpose of increasing the dimension of factors is doing better identification and analysis in order to manage and control.

5 Construct Highway Project Construction Schedule Goal Programming

5.1 The Contents of the Schedule Target Planning System in Highway Project

The goal of the highway project construction schedule plan is based on the overall goal in clear and specific objectives, by using comprehensive knowledge, as the systems theory, risk management and information theory etc., based on series of activities in schedule target planning system in highway project on the owner's point of view. Controlling the program by express the project through the planning to carry out the work order, start and completion time, the plan of relationship and coordinating between the interface [12]. Therefore, the contents of the highway project construction schedule target planning should be systematic and comprehensive, covering the whole process of construction of highway projects as much as possible.

Should include the following:

(1) Planning of the project's total program schedule. The total program schedule is based on the project description and the project scope definition of the progress of programs and projects in, project work breakdown, task description of project activities

etc. Planning the progress of plans and the general content of the system and the subsystem on a view strategic

(2) Planning of the risk management in the whole process of project. Firstly, divided the whole process of the project at all stages, to clear the manpower, resources allocation in every stage and; Secondly, identified the project risks and develop appropriate measures of risk aversion guided by the theory of risk management; thirdly, made the risk mitigation programs under constraints and develop ongoing risk assessment methods.

(3) The made of sub project schedule planning. The schedule planning is developed based on the total progress, making scientific forecast and identify future action programs to achieve the sub-goals.

(4) Control and coordination of the goal of the project construction schedule planning. In the project implementation process, the actual and planned progress often biased, the project managers should adjust, coordinate and control resources based on the actual schedule in time, to ensure the project is not out of "track."

5.2 The System Diagram of Highway Project Construction Schedule Goal Planning

In summary, this paper defines the scope of highway project goal planning in six perspectives. It can be classified into two systems by systems theory as a guide: the internal systems and external systems of highway project construction schedule planning, they can be represented by two three-dimensional graphical representations, as shown in Figure 3.

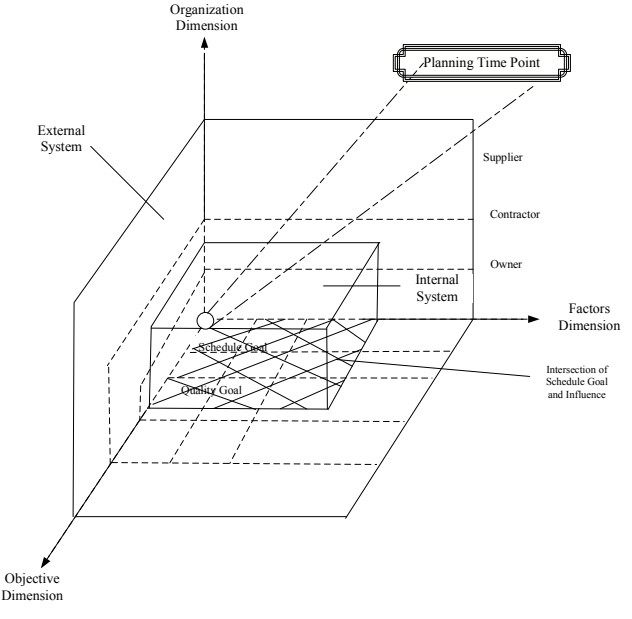

Fig. 3. Three-dimensional definition of highway project scope

Obviously, the internal system of highway project construction schedule planning is included in the external system, the organization dimension of highway project is designed based on the perspective of the definition of the project participants, target dimension and time dimension inherent in the system is overlap, so the time dimension inherent in the system does not show, only time points in the planning stage. Factor dimension and internal system objects dimension overlap, the shaded part represents the affecting factors that should be avoided and controlled in the highway project schedule objectives.

6 Conclusion

The system of highway project construction schedule objectives involves many factors in a wide range. The construction of multi-dimensional target construction schedule planning system, can survey the uncertain factors during the project more comprehensively. By disposing timely and effectively with risk management tools, it can be make sure that the project be completed within a definite time. However, to be directed against the related uncertainty and dynamic factors of the highway project construction schedule objectives system, it's necessary to make countermeasure, so as to find and solve problems timely to ensure the achievement of project objectives.

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Sequence Analysis Based Adaptive Hierarchical Clustering Approach for Admixture Population Structure Inference

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Abstract. Population structure inference is an important problem in many areas of human genetics. However, it is very difficult to infer the structure of the admixture population. The traditional Bayesian methods are often time-consuming and may run into convergence problem. Thus, we propose a novel approach to rapidly infer the admixture population stratification on genotype data. The cost of inference can be reduced and the noises can be eliminated by feature selection step. The genetic distance between two individuals is calculated through a sequence analysis algorithm and the distance matrix is used in an adaptive hierarchical clustering algorithm to infer the population structure. Compared with the software based on Bayesian methods (e.g., STRUCTURE), our approach has more efficient computations and the obtained stratification of admixture population is more accurate.

Keywords: admixture population structure inference, feature selection, sequence analysis, genetic distance, adaptive hierarchical clustering.

1 Introduction

The information about population structure is useful in a variety of genetic researches, such as evolution studies and disease association researches. The determinate population stratification can avoid the spurious associations between a candidate marker and a phenotype in association studies and so on [1,2,3]. Thus, more and more researchers devote themselves to the population structure inference study.

Population structure inference can be defined as a problem which aims to assign each individual in a population to several population clusters, and individuals in different clusters have remarkable genetic variations. Thus, several statistical methods based on genetic information have been proposed to inference population structures using genotype data [4,5,6,7].

In current statistical-based methods, Bayesian model-based methods are the most widely used ones. Pritchard and Stephens [8,9] firstly introduced a Bayesian model-based clustering method to infer population structure using genotype data (the corresponding software is called STRUCTURE). Hubisz and Falush [10] extended

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this method to make it adapt to the loose or null linkage between loci. However, the Bayesian-based inferring methods usually have the high time complexity and are easily being trapped in local optima. The improved method [11,12] can accelerate the inferring process, but usually lose the generality and the results are easily affected by noise. All these methods above have difficulties of inferring the structures for the populations which have the genetic features mixed with other populations. These population data is also called admixture population. Current methods usually obtain ambiguous clusters and could not accurately describe the population structure for these admixture populations.

Thus, in this paper, we propose a new approach to infer the admixture population genetic structure. The significant single nucleotide polymorphisms (tagSNPs), which contain the abundant genetic variation information to represent the whole genotype data, are selected to reconstruct the genotypes and the noises are eliminated. A sequence analysis algorithm is used to evaluate the genetic distance between two individuals. Then, an adaptive hierarchical clustering algorithm is proposed to determine the population stratification. The experimental results indicate that our method can produce more accurate assignments using less time on general data and the inferring accuracies on admixture populations are highly improved by our approach.

2 Methods

Since the population structure inference is usually treated as a clustering problem, there are two key points of it, the principal feature selection and the cluster number estimation. In our approach, the genotypes are firstly preprocessed by a feature selection algorithm. The most informative SNPs, which are also called tagSNPs, are selected and are used to reconstruct the genotypes. Then, the genetic distances are evaluated by sequence analysis algorithm and an adaptive hierarchical clustering algorithm is employed to infer the population clusters. The next subsections will describe these steps in detail.

2.1 Feature Selection

In clustering procedure, the SNPs are regarded as the clustering features. There usually have many noisy loci and redundant loci in genotype data. These sites are regarded as the invalid features in the clustering procedure. It is very time-consuming to analyze these sites. Thus, we introduce a graph based feature selection algorithm which has been proposed in our previous work [13] to eliminate these invalid features.

In our method, tagSNPs are chosen as the principal features for their concentrated genetic information. TagSNPs are defined as the sites which have high linkage disequilibrium (LD) values with its related sites and contain abundant genetic variation information to represent the whole variations in given genotype data. The genetic relationship of SNPs is described by SNP graph. Each SNPs relates to a vertex in the graph, and each edge in graph reflects the genetic diversity information coverage of two SNPs. Real tagSNPs are surrounded by their related SNPs and these

site clusters are shown as high density subgraphs in the graph. For each subgraph in SNP graph, the algorithm defines a function $T(\lambda,EP)=\theta\lambda+EP$ to integrate the graph density λ and the genetic diversity information content EP of it. Then, the algorithm iterately chooses the subgraph which has the highest T value and evaluates the diversity information of each SNPs in this subgraph. The site, whose diversity information can be represented by other related sites, is decided as non-tagSNP and deleted from the graph. After all sites in SNP graph are evaluated, the remained sites are seen as tagSNP candidates. The real tagSNPs can be determined by a voting mechanism on tagSNP candidates.

The selected tagSNPs are used to reconstruct the original genotypes. The length of the reconstructed sequences is much smaller than the length of original sequences. Using these new genotypes to infer population genetic structure will shorten inferring time. Most of the noises are eliminated from the original data and it will partly avoid the negative impact of noises in the clustering procedure. Besides, most of the redundant features are deleted and the influence of their genetic information on admixture population will been remarkably weakened in the inferring procedure.

2.2 Genetic Distance

To avoid the indeterminacy of the inferring results of current methods and to reduce the time complexity of parameter evaluation, we propose a sequence analysis based adaptive hierarchical clustering approach for admixture population structure inference. The clustering algorithm firstly needs to define a genetic distance. The genetic distance measure of current method usually focuses on the sequence divergence on single site. The genetic associations among SNPs and the sequence structure divergence, which contains important genetic variance information, are ignored. Thus, a new genetic distance is defined to integrate the whole sequence genetic diversity and the sequence structure similarity.

According to the theory of evolution and population geography, the homologous genotypes can be transformed to each other through the linkage transformation on loci which is based on the site associations and allele frequency differences. Thus, in our approach, the sequence genetic diversity between two instances is defined as the whole sequence transformation complexity between two instances. For a population set G, which has n genotypes with m SNPs, assuming the genotypes g_1 and g_2 have l different SNPs, there are l different transforming paths from g_1 to g_2. Each path corresponds to a locus transformation order. g_1 can transform to g_2 through changing the different sites one by one following a given order. A transforming function is defined to describe one transforming path from g_1 to g_2. t_i relates the locus changing on site i. Thus, there are l different $\bar{t}$ for the l paths from g_1 to g_2.

$$g_2=\bar{t}(g_1)=t_l(t_{l-1}(...t_1(g_1)...)) \qquad \bar{t}=t_1,...,t_l \tag{1}$$

For each t_i, the algorithm defines a distribution function $p(t_i)$ to describe the transforming probability of single locus i. For the transformation from genotype g_1 to g_2, the transformation probability $P(g_2|g_1)$ can be described as $p(\bar{t})$.

$$P(g_2 \mid g_1) = p(\bar{t}) = \prod_{i}^{l} p(t_i) \tag{2}$$

$$p(t_i) = \begin{cases} (1 - p_1)\, p_2 & s_{i1} \neq s_{i2} \\ p_1 + (1 - p_1)\, p_1 & s_{i1} = s_{i2} \end{cases} \tag{3}$$

where s_{i1}, s_{i2} represent the allele on SNP site i in genotype g_1, g_2; p_1, p_2 are the frequencies of s_{i1} and s_{i2} on SNP site i in the whole genotype set G. When $p_1 \neq p_2$, the $p(t_i)$ for transforming s_{i1} to s_{i2} should not equal to the $p(t_i')$ for transforming s_{i2} to s_{i1}. Thus, if the allele frequencies are different on some SNP sites between g_1 and g_2, it is obviously that $P(g_2|g_1) \neq P(g_1|g_2)$.

The transforming complexity of g_1 and g_2 is defined as the information entropy of two transformations: $g_1 \rightarrow g_2$ and $g_2 \rightarrow g_1$. Then, the sequence genetic diversity d between two individuals is defined as:

$$d(g_1, g_2) = \frac{-(P(g_2 \mid g_1) \log_2 P(g_2 \mid g_1) + P(g_1 \mid g_2) \log_2 P(g_1 \mid g_2))}{2} \tag{4}$$

There are four basic bases $\{A, G, C, T\}$ in genotypes. For one base $S \in \{A, G, C, T\}$, it assumes that there are $(k+1)$ S in a given genotype ($k \leqslant m$, m is the length of the given sequence). The number of sites between the i-th S and the $(i+1)$-th S is s_i ($i=1, 2,\ldots, k$). The density degree of base S in the given sequence can be represented by the `variance` of $\{s_1, s_2,\ldots, s_k\}$.

$$Var_S(s_1, s_2, \ldots, s_k) = \sqrt{\frac{1}{k-1} \sum_{i=1}^{k} (s_i - \bar{s})^2}, \quad \text{where } \bar{s} = \sum_{i-1}^{k} s_i / k \tag{5}$$

The algorithm can get a base frequency vector $Var=\{Var_A, Var_G, Var_C, Var_T\}$ for each individual. The genetic sequence structure can be represented by Var. The sequence structure similarity coefficient of sequences g_1 and g_2 can be defined as:

$$SC(g_1, g_2) = -\ln \frac{\sum_{S \in \{A,G,C,T\}} Var_{sg_1} Var_{sg_2}}{\sqrt{(\sum_{S \in \{A,G,C,T\}} Var_{sg_1}{}^2)(\sum_{S \in \{A,G,C,T\}} Var_{sg_2}{}^2)}} \tag{6}$$

The genetic distance of two individuals g_1 and g_2 can be calculated as equation (7), where χ, γ are the regulating factors.

$$GD(g_1, g_2) = \chi d(g_1, g_2) + \gamma SC(g_1, g_2) \tag{7}$$

2.3 Adaptive Hierarchical Clustering Algorithm

Estimating the number of clusters is always a difficult problem in population structure inference. Thus, after the sequence analysis based algorithm constructs the distance matrix GD, an adaptive hierarchical clustering algorithm is employed to infer population structure. Instead of estimating the cluster number K, the algorithm output all valid clustering results for different K by gradually changing the value of the cut-off merging distance D in the clustering procedure.

The value region of D can be adaptively set according to the genetic distance matrix GD at the beginning of the clustering process. The value region of D is defined as [$\overline{d}$ $-S$, $\overline{d}$ $+S$].

$$S = \sqrt{\sum_{i=1}^{n} (ad_i - \overline{d})^2 / (n-1)} \quad \text{, where } \overline{d} = \sum_{i}^{n} ad_i / n \tag{8}$$

where ad_i is the average distance of one genotype i to all the other genotypes in given set G, n is the size of G. After the value region is calculated, the algorithm assigns a growth pace $x=S/5$ to D. The adaptive inferring procedures can be described as follow:

(1) At the beginning of the clustering, each individual g_i is treated as a single cluster in the space.

(2) Finding the cluster pairs which have the smallest between- cluster distances. The between-cluster distance $DC(C_i, C_j)$ is defined as:

$$DC(C_i, C_j) = \alpha SD(C_i, C_j) + \beta GD(C_i, C_j) \tag{9}$$

where α, β are the regulating factors. $SD(C_i, C_j)$ is the genetic diversity between two clusters, $GD(C_i, C_j)$ is the genetic distance between two clusters.

$$SD(C_i, C_j) = \frac{\sum_{x=1}^{m} SI_x(C_i, C_j)}{m} \tag{10}$$

m is the size of SNP set, $SI_x(C_i, C_j)$ is the genetic diversity between two clusters on the SNP site x.

$$SI_x(C_i, C_j) = \frac{-(\sum_{y=1}^{k} p_y^2(C_i, C_j) \ln p_y^2(C_i, C_j) + 2\sum_{y<z} p_{yz}(C_i, C_j) \ln(p_{yz}(C_i, C_j)))}{\ln k} \tag{11}$$

$$\begin{aligned} p_y^2(C_i, C_j) &= | p_y^2(C_i) - p_y^2(C_j) | \\ p_{yz}(C_i, C_j) &= | p_y(C_i) p_z(C_i) - p_y(C_j) p_z(C_j) | \end{aligned} \tag{12}$$

where k is the number of different alleles on locus x and $p_y(C_i)$ is the frequency of allele y on locus x in cluster C_i.

$$GD(C_i, C_j) = \frac{\sum GD(g_{c_i}, g_{c_j})}{|C_i| * |C_j|} \tag{13}$$

where $|C_i|$,$|C_j|$ are the size of cluster, $GD(C_i, C_j)$ is the average genetic distance of the individuals in two clusters.

(3) If the $Min(DC(C_i, C_j)) < D, (D \in [\overline{d} - S, \overline{d} + S])$, merging these cluster pairs into one single cluster. Each individual in the new merged cluster is reassigned to the cluster which has the maximum membership coefficient with this individual. The membership coefficient of one individual to a cluster is defined as:

$$Coef(g \mid C) = \frac{\sum_{g_i \in C} GD(g, g_i)}{|C|} \tag{14}$$

The distances between each cluster pairs are recalculated. Then, repeating the step (2)-(3).

(4) If the $Min(DC(C_i, C_j)) \geq D, (D \in [\overline{d} - S, \overline{d} + S])$, a new population partition result cp_i is obtained and put into the candidate set CP. D increases as $D=D+x$. Repeating the step (2)-(3).

(5) When $D > \overline{d} + S$ or all individuals have been merged into a single remaining cluster, the clustering procedure stops, and a validation mechanism is employed to evaluate the quality of obtained candidate results and eliminate the invalid cluster sets. For the partition candidate result set $CP=\{cp_1, cp_2, \ldots, cp_j\}$, the similarity of two partitions is defined as:

$$Si(cp_a, cp_b) = 1 - \frac{Dis(cp_a, cp_b)}{n} = 1 - \frac{\min \sum_{ij} x_{ij} \left| a_i \cap \overline{b_j} \right|}{n} \tag{15}$$

where n is the number of the individuals in population set G, a_i is an individual cluster in partition cp_a, b_j is an individual cluster in partitions cp_b, x_{ij} is a permutation matrix allowing for arbitrary combination of clusters from cp_a and cp_b such that each cluster is used only once. The algorithm successively selects the partition which has the maximum average similarity with the other sets in CP, and put it into the final result set FC. The other partitions, which have high similarities with the selected partition (the threshold of similarity is set as 0.9 by training), are eliminated as the invalid results. When CP is empty, the algorithm output FC as the final inferring result.

3 Results and Discussion

3.1 Data

Both simulated and real data are used in our experiments to evaluate the performance of our method. Three simulated datasets are generated by software GENOME [14]. Each of them has 100 individuals and these samples come from independent populations. The real data is downloaded from database of the Human Genome Diversity Project (HGDP) [15]. It contains 650 individual genotype samples with all missing genotypes deleted. Each genotype sample consists of 2,810 biallelic SNPs. These individuals are geographically far from each other but have admixture genetic attributes with each other. The performance of our method can be evaluated by the similarity between two partition result A and B. The inference accuracy can be calculated as:

$$ACC = Si(A, B) = 1 - \frac{Dis(A, B)}{n} \tag{16}$$

3.2 Experiment Results

In our experiments, we compared our results with the standard clusters and the results of STRUCTURE. For simulated data, the feature selection algorithm selects 181 principal features from 4,400 SNPs. The program obtains only one result which has 3 population clusters after validation. All results for simulated data are shown in Table 1. In the experiments, our method calls AH. We can find that the boundaries of the three clusters obtained by STRUCTURE are not very clear; the population 1 and 3 are mixed with the other population. But AH can clearly depart them. All these results show that our method can reduce the influence of noisy and non-informative variations and performs better than STRUCTURE on simulated data.

Since there are no standard results on real data, the results of AH are only compared with the results of STRUCTURE, and only the minimum distance between them is given. 148 principal features are selected from 2,810 SNPs. For these admixture population data, AH obtains 3 partition results, which have the cluster number K=2, 3, 5. The experiment results are shown in Table 2.

Table 1. The results for simulated data

Clusters	AH (All/True)[a]	STRUCTURE (All/True)	Standard partitions
Cluster1	97/94	97/80	100
Cluster2	92/90	85/79	100
Cluster3	111/99	118/85	100
ACC	0.9300	0.8133	~
times	5 min	15 min	~

a. All relates the number of the individuals in the obtain cluster. True relates the number of the individuals which are also appeared in standard cluster.

Table 2. The results for the real Data

K	Clusters	AH (All/Same)[a]	STRUCTURE (All/Same)	Partition Distance
K=2	Cluster1	490/490	547/490	0.0877
	Cluster2	160/103	103/103	
K=3	Cluster1	452/213	222/213	0.3677
	Cluster2	103/103	103/103	
	Cluster3	95/95	325/95	
K=5	Cluster1	223/217	217/217	0.0092
	Cluster2	27/27	27/27	
	Cluster3	62/62	63/62	
	Cluster4	103/103	103/103	
	Cluster5	235/235	240/235	

a. All relates the number of the individuals in the obtain cluster. Same relates the number of the individuals which are also appeared in the related cluster obtained by another method

For K=5 which relates to the optimal partition result of AH on real data, AH produces similar partition to the one generated by STRUCTURE. But the boundaries of the clusters obtained by AH are clearer than these obtained by STRUCTURE. There exists big differences between partitions obtained by AH and STRUCTURE at K=2, 3. These differences are mainly caused by the populations from America. These individuals are admixture population which has the genetic features mixed with other populations. According to the studies of human evolution and the geographic location, populations from East Asia may be more similar to the populations from Central South Asia than the populations from America. And the populations from America have high genetic similarity with the populations from Africa when taking into account the similar climate and geographic conditions. Thus, the partitions produced by AH are more reasonable. This experiment proves that the AH can get more accurate results when the data contain the admixture population. Besides, the results show that AH saves almost half of the running time of STRUCTURE (AH runs 25 min and STRUCTURE runs 65 min on real data). The reduction of running time is more significant when the size of data increases.

4 Conclusion

In this paper, we propose a novel method for admixture population structure inference. Our method combines the sequence analysis algorithm and the adaptive hierarchical clustering algorithm to improve the accuracy of admixture population stratification determination. The improvements of our method are: (1) the feature selection algorithm can eliminate the noises and redundant sites in the original data. It can save the cost of the inferring procedure. (2) A sequence analysis based algorithm can highly integrate the whole sequence genetic diversity and the sequence structure similarity to evaluate the genetic distance between the individuals. (3) The adaptive clustering algorithm can reduce the information loss in the traditional methods and avoid the indeterminacy of the inferring results of current methods. It can highly improve the accuracy of admixture population structure inference. The experimental results show that our method performs better than STRUCTURE on both the simulated data and real data. Our method produces more reasonable partitions on admixture data and highly reduces the computational complexity.

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A New Integer FPE Scheme Based on Feistel Network

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Abstract. Format-preserving encryption implies a block cipher which encrypts a plaintext of some specified format into a ciphertext of identical format. In the paper, we make an overview of various types of Feistel networks used in FPE schemes and show that all Feistel networks divide the input into two sub-blocks. Then we present an integer FPE scheme based on type-2 Feistel network which divides the input into k sub-blocks (here k=4) to provide better diffusion and be better immunity to differential cryptanalysis.

Keywords: Format-preserving encryption, Symmetric cryptography, Block cipher, Feistel network, Type-2 Feistel network.

1 Introduction

Background

Modern business activities have a high demand in privacy, which has motivated many corporations to investigate methods to encrypt personally identifiable information (PII) and minimize the repercussions of losing data. However, traditional encryption methods will expand data and change its format, which demands the cost of modifying databases and applications to accommodate the encrypted data. For that reason, Spies firstly introduced the notion of FPE (format-preserving encryption) and proposed a practical integer FPE scheme, which encrypts a plaintext of some specified format into a ciphertext of identical format, to make a transparent database encryption [1].

Related Work

The problems associated with FPE can be backdated to 1981[2]. Then, in 1997, Brightwell and Smith discussed the problems of encryption in data warehouse and identified what they termed datatype-preserving encryption (DTP)[3].

In 2002, Black and Rogaway proposed three methods to solve FPE problem on a special domain $X=Z_n$, where $Z_n=\{0,1,\ldots,n-1\}$[4]. The prefix method just enciphers each point in X with block cipher E and uses the ordering of $E_k(0)$, $E_k(1)$, up to $E_k(n\text{-}1)$ to construct a random permutation on X, but this technique is only suitable for small value of n. The cycle-walking method, which encrypts plaintext with an existing block cipher repeatedly until cipher output falls in acceptable range, can be used in most cases, however, when the size of domain is much smaller than 2^{2m} where $2m$ is

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the applied block cipher size, its performance will be much low. What is more, owing to the nondeterministic duration of encrypt process, this could lead to some problem in applications, even if the potential threat of timing attack should not be harmful[5]. The generalized-feistel method uses Feistel network to construct a block cipher of approximately the right size and combines with cycle-walking method to get output into acceptable range. The method can be quite efficient, though the proven bounds are weak when domain is not large.

In spite of many drawbacks, the three methods can solve FPE problems in integer set Z_n in some specific cases and have become the basis for designing FPE schemes and modes.

We note that the generalized-feistel method get the most attention: since 2008, the FPE schemes proposed are all combined with generalized-feistel method to design symmetric ciphers, such as FFSEM[6], FFX[7] and BPS[9], etc.

Motivation

The Feistel network in generalized-feistel method is a symmetric structure used in the construction of appropriate sized-block ciphers. It has the advantage that encrypt and decrypt process are very similar, requiring only a reversal of the sub-key schedule.

In the paper, we review the classification of Feistel networks and make an overview of all types of Feistel network applied in FPE schemes. To achieve better diffusion, we then introduce three special types of Feistel network, the type-1, type-2 and type-3 Feistel network. From the diffusion[10], avalanche[11] and security[12] analysis, we get that type-2 Feistel network must be the most preferable one and is the optimal structure for the design of a flexible block cipher. At last, we further present an integer FPE scheme based on the type-2 Feistel network which can be better immunity to differential cryptanalysis[12].

2 Formal Definition of FPE

A scheme for format-preserving encryption (FPE) can be considered as a function $F: K \times \Omega \times T \times X \to X \bigcup \{\perp\}$, where the sets K, Ω, T and X are called the key space, format space, tweak space and domain respectively. All of these sets are nonempty and $\perp \notin X$. For each $\omega \in \Omega$, it corresponds with a set X_ω which is a subspace of X. This set X_ω is called ω-indexed slice of domain, each slice must be a finite set. In summary, an FPE cipher on a domain X can be considered as a permutation which is made up of sub-permutation on each slice of X. In this paper, we only concern the case that $|\Omega|=1$ and $X=Z_n$ and attempt to provide integer FPE scheme as solution.

We can present a triple of algorithms to describe FPE:

$$fpe = (keygen, encryption, decryption).$$

Algorithm *keygen*: Specifies the manner in which the key to be chosen. In most cases this algorithm simply returns a random string of the key length. It is noted that the key must be stored safely, not published outside.

Algorithm *encryption*: Receives a tweak t and a plaintext x as input and outputs a ciphertext $y = \mathrm{E}_k^{\omega,t}(x)$ or $\perp$.

Algorithm *decryption*: An inverse process of *encryption*. It receives a tweak t and a ciphertext y as input and outputs a plaintext x when and only when $\mathrm{E}_k^{\omega,t}(x) = y$.

3 Feistel Networks Applied in FPE

Feistel network is a symmetric structure used in the construction of block ciphers. The classical structure for a given bit length $2n$ consists of multiple rounds of dividing input into two sub-blocks with equal length and using some pseudo random function as round function which takes n bits and outputs n bits[13]. Afterwards, many Feistel-like ciphers have come in several flavors beyond the classical one. Hoang and Rogaway have summarized generalized Feistel networks which encompass most all of them (including the classical one)[14]. They further classified generalized Feistel networks into five classes:

- Classical Feistel networks, it is balanced where the input is split up into two blocks with equal in length.
- Unbalanced Feistel networks, where the input is split up into two blocks with unequal in length.
- Alternating Feistel networks, where the round functions alternate between contracting and expanding;
- Type-1, type-2, and type-3 Feistel networks, where the input is split up into k blocks with equal in length and n-bit to n-bit round functions are used to encipher kn-bit strings for some $k \geq 2$;
- Numeric variants of any of the above, where one enciphers numbers in some given range rather than strings of some given size.

For the reason that Feistel network can be used in the construction of block cipher, many FPE schemes utilized this tool to make a pseudo random permutation on domain. Up to now, many Feistel-based solutions to FPE problem have been presented[4][6][5][8].

We summarize the various types of Feistel network used in FPE schemes in table 2.

From the table above, we can see that all types of Feistel network used in proposed FPE schemes just split the input into two sub-blocks in common, and then do some individual round operations, respectively. We can call them 2-splits Feistel network. Beyond FPE scheme, the 2-splits Feistel network is widely used in well known block ciphers, such as Skipjack, BEAR/LION, etc.

However, for a flexible block sized cipher, a fast diffusion is in great demand so that as the block size increases, the number of rounds required does not increase exponentially. Yet, the 2-splits Feistel network cannot provide sufficient diffusion in each round and demands too many Feistel round operations for encrypt and decrypt process in some cases.

Table 1. Feistel Network Used In FPE Scheme

FPE scheme	Feistel network
Generalized-Feistel[4]	Numeric alternating Feistel network
FFSEM[6]	Classical Feistel network
FFX[7]	Unbalanced Feistel network
	Alternating Feistel network
Feistel-based integer FPE (in RtE)[5]	Numeric unbalanced Feistel network
	Numeric alternating Feistel network
A scheme based on Thorp Shuffle[8]	Unbalanced Feistel network
BPS[9]	Alternating Feistel network

4 Special Types of Feistel Network

The type-1, type-2 and type-3 Feistel network were first introduced by Zheng, Matsumoto and Imai[15]. The three types split the input into k sub-blocks and then do some individual round operations respectively.

As shown in Fig.1 which illustrates the k=4 case, all three types split the input into four blocks: X_1, X_2, X_3 and X_4, and then try to process them through established rules:

- Type-1 Feistel network makes a XOR operation between $F(X_1)$ and X_2, denotes the result as X_2', and combine $X_2'||X_3||X_4||X_1$ as the input for next round.
- Type-2 Feistel network makes a XOR operation between $F_1(X_1)$ and X_2, $F_2(X_3)$ and X_4, denotes the result as X_2', X_4' respectively, and combine $X_2'||X_3||X_4'||X_1$ as the input for next round.
- Type-3 Feistel network makes a XOR operation between $F_1(X_1)$ and X_2, $F_2(X_2)$ and X_3, $F_3(X_3)$ and X_4, denotes the result as X_2', X_3', X_4' respectively, and combine $X_2'||X_3'||X_4'||X_1$ as the input for next round.

The three types Feistel networks can all provide strong diffusion and have been used to construct well known block ciphers including CAST-256 (type-1), RC6 (type-2), MARS (type-3). Among them:

- As the diffusion analysis in [10], type-2 Feistel network is suitable for cipher which employs many sub-blocks as the scheme can achieve the same level of security with less number of rounds as compared to type-1 Feistel network. Type-3 Feistel network is computationally expensive because it requires many pseudo random functions for its transformation.
- As the avalanche analysis in [11], the performance of type-2 Feistel network is not far behind that of type-3 Feistel network and type-2 Feistel network requires half the number of pseudo random functions as type-3 Feistel network.
- As the security analysis in [12], type-2 Feistel network and type-3 Feistel network have better immunity to differential cryptanalysis than a classical Feistel network when a linear transformation has a low diffusion property.

Considering the all above, type-2 Feistel network is the most preferable structure for the design of a flexible block cipher.

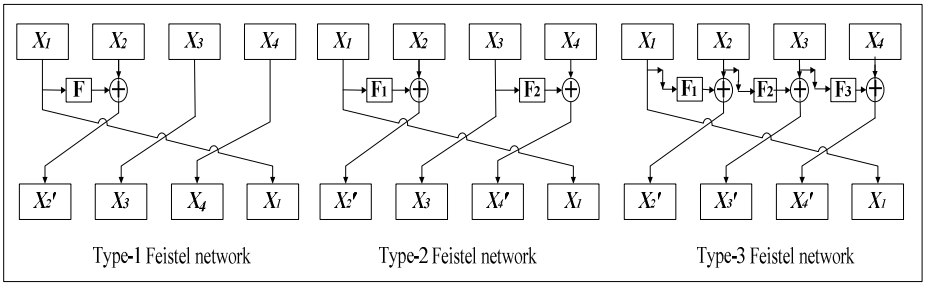

Fig. 1. Type-1, type-2 and type-3 Feistel network (k=4 case)

5 An Feistel-Based Integer FPE Scheme

In this section, we attempt to present a practical integer FPE scheme based type-2 Feistel network.

Following the formal definition of FPE, we explain our scheme as a triple of algorithms:

fpe_int=(*keygen, encryption, decryption*)

For the reason that Feistel network has the similar process in decryption and encryption, we would like to only show *keygen* and *encryption* in detail.

Keygen Algorithm

keygen algorithm is executed to generate a (128×2)-bit binary string as a key. It is noted that the key space cannot cover all of (128×2)-bit binary strings, because we should make the pseudo random function in type-2 Feistel network different. We have two demands to this algorithm: (1) *keygen* generates an unique key; (2) for each key generated by *keygen*, denote the front and end 128-bit binary string as k_f and k_e, respectively, which must satisfy $k_f \neq k_e$. One alternative *keygen* is described in Fig. 2.

It is noted that GetCurrentTime() returns system time at present, to the accuracy of μs, K_1 and K_2 are keys used by KDC (Key Distribution Center).We achieve two different parts of key through encrypting the current time which is changing whenever necessary.

Algorithm *keygen*
Input: none
Output: the key generated, k
$k_f \leftarrow E_{AES}(K_1, GetCurrentTime())$;
$k_e \leftarrow E_{AES}(K_2, GetCurrentTime())$;
return $k = k_f \| k_e$;

Fig. 2. *keygen* algorithm

Encryption Algorithm

The *encryption* algorithm is based on type-2 Feistel network.

As shown in Fig. 1**,** the type-2 Feistel network splits the input block into four blocks in equal length and computes $X_2^{'} = F_1(X_1) \oplus X_2$ and $X_4^{'} = F_2(X_3) \oplus X_4$, after that takes $X_2^{'} \| X_3 \| X_4^{'} \| X_1$ as the input for next round.

Correspondingly, we show the type-2 Feistel network procedure in Fig. 3. The *feistel* algorithm expresses the input integer x in its binary representation x_{bin}, and splits x_{bin} into four blocks in equal length, then, according to the type-2 Feistel network type (we only concern the condition for four blocks), executes the round operation for r times.

Algorithm *feistel*
Input: the key, k;
the input item, x;
the tweak, t;
the Feistel round times, r;
Output: the encrypted item, y;
represents k in $k_f \| k_e$ where $|k_f| = |k_e| = 128$;
represents x in its coded binary form, x_{bin};
splits x_{bin} into four blocks: x_1^0 , x_2^0 , x_3^0 , x_4^0 in equal length (if $|x_{\text{bin}}|$ is not enough, padding with zero);
for i←0 to r-1 do
$x_1^{i+1} \leftarrow \mathrm{F}_1(k_f, t, i, x_1^i) \oplus x_2^i$;
$x_2^{i+1} \leftarrow x_3^i$;
$x_3^{i+1} \leftarrow \mathrm{F}_2(k_e, t, i, x_3^i) \oplus x_4^i$;
$x_4^{i+1} \leftarrow x_1^i$;
end
represents $x_1^r \| x_2^r \| x_3^r \| x_4^r$ in its decimal form, y;
return y;

Fig. 3. *Feistel* algorithm

It is noted that in our scheme F_i is a pseudo-random function (i=1 or 2), which maps an m-bits binary string to another m-bits binary string. We can follow the direction of [6] to construct the pseudo random functions with the underlying cipher AES.

Here we state that our *feistel* algorithm can only independently work for domain Z_m where m is some power of 2. For Z_n (n is arbitrary integer) or more complex domain, our scheme must combine with cycle-walking[4] which is used to transform the encrypted value to in acceptable range.

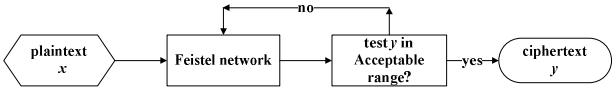

Fig. 4. Feistel-based integer FPE scheme diagram

We present our scheme in Fig. 4, it firstly takes the plaintext x as the input of the Feistel network and then test whether the output of the Feistel network y is in acceptable range. If so, takes y as the ciphertext; if not, takes y as the input and do another round Feistel operation until the condition is met.

Security

Feistel network is a classical symmetric structure used in the construction of block ciphers. It has been proved secure: Luby and Rackoff have proved that when $m \ll 2^{n/2}$, the scheme is secure against chosen ciphertext attacks (CCA)[13] (here m is the number of plaintext/ciphertext pairs and n is the Feistel block size); in 2004, Patarin further showed that if Feistel network is run with a sufficient number of rounds, the number of ciphertext/plaintext pairs needed by an attacker approaches the theoretical maximum, which is the square root of the size of the entire plaintext[16].

In [14], Hoang and Rogaway proved beyond-birthday-bound security for the type-2 Feistel network. They showed CCA-security of type-2 Feistel network to $2^{n(1-\varepsilon)}$ queries for any $\varepsilon > 0$, which is undoubtedly a disappointing bound when n is small (here n is the Feistel block size). But the type-2 Feistel network is motivated by a desire to keep n small despite a long block length. In [15], the authors substantially improved the prior bound to achieve the asymptotic behavior.

Security of the Feistel-based integer FPE algorithm is totally depended on that of the type-2 Feistel network. As shown above, the provable secure of type-2 Feistel network ensures the secure of our scheme.

6 Conclusion

Black and Rogaway proposed three methods to build FPE programs in 2002, but prefix can only used in small scaled encryption and the cycle-walking method is inefficient, so the generalized-feistel cipher has been the most widely used method to build a FPE scheme.

Up to now, many FPE solutions based on Feistel network have been presented. But all they used are 2-splits Feistel network, which cannot provide sufficient diffusion in some cases. Type-1, type-2 and type-3 Feistel networks, which have a high speed of diffusion, have been used in many well known block ciphers. From the analysis in [10][11][12], we know type-2 Feistel network is the best, so we attempt to present a new FPE scheme based on it.

The scheme we proposed is just based on type-2 Feistel network. It's of strong confusion and diffusion since a single bit of plaintext will lead to half bits of ciphertext changed on average. Additionally, by the reason that type-2 Feistel network has a better immunity to differential cryptanalysis than classical Feistel network, our scheme can achieve a higher security level than classical Feistel network-based FPE scheme, such as FFSEM[6], etc.

Another advantage of our scheme is that it could be easily extended to other FPE problems on complex domain although it is designed to be applied to integer set encryption. At the same time, it should be noted that the new scheme still needs to be combined with cycle-walking to be built up.

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The Research on ACARS Digital Signal Demodulation Method

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Abstract. According to ACARS communication mode, considering the mathematical characteristics of MSK signals, based on the analysis of MSK digital demodulation algorithm, the improved algorithm is analyzed. And the existing Gaussian noise background, the algorithm of demodulation error performance is analyzed either. Simulation results show that the improved algorithm is small computation, good anti-jamming performance, is more suitable for ACARS digital demodulation.

Keywords: ACARS, MSK, Digital demodulation, BER.

1 Introduction

Our Air-ground data link uses the U.S. company ARINC aircraft communications, addressing and reporting systems (ACARS), which consists of airborne subsystem (management unit, control unit), VHF remote ground station (RGS), and ground data communications network, ground network management and information processing systems and data link user. ACARS can not only send a message from the aircraft to the ground station but also send digital information from the ground station to the aircraft.

In the VHF ground data link system, the signal transmission is VHF radio signal transmission. Therefore, the spectrum needs to move the modem to complete the work, convert the digital signals into Digital frequency signal for channel transmission, and then transmit by carrier modulation. Received signals, ground stations is need to do the digital demodulation work [1].

Minimum frequency shift keying (MSK) is a special kind of binary frequency shift keying (2FSK) signals.There are many ways to MSK demodulation, generally as a special FSK signal demodulation, and there are other various methods[2]. In this paper on the basis of predecessors, DFT methods based on the number of MSK signal demodulation algorithm is analyzed. And comparing with the traditional method, this paper discusses the advantages of this methods through the simulation, for digital demodulation signal in the MSK method has the new breakthrough, the ultimate aim is to better used ACARS system [3].

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2 The MSK Signal Digital Demodulation Method

Digital Quadrture Demodulation Algorithm

At present, the digital demodulation of signal usually adopts the traditional digital orthogonal demodulation algorithm, as shown in figure 1 , the basic principle can be reduced to the following several steps:

Step1: The received MSK signal is devided into two branches with filtrating off the noise after going through BPF, the upper branch is multiplied with a coherent carrier which frequency equals f_1, the lower branch is multiplied with a coherent carrier which frequency equals f_2 .The local frequency-shifting carrier waveform ($\cos 2\pi f_1 t$) and ($\cos 2\pi f_2 t$) is synchronized with 0 code wave and 1 code wave.

Step2: After a code-element period integrating, the upper output is p_1 ; the lower output is p_2 .

Step3: compare p_1 and p_2 , if p_1 less than p_2 , the signal is 0 code,otherwise, the signal is 1 code.

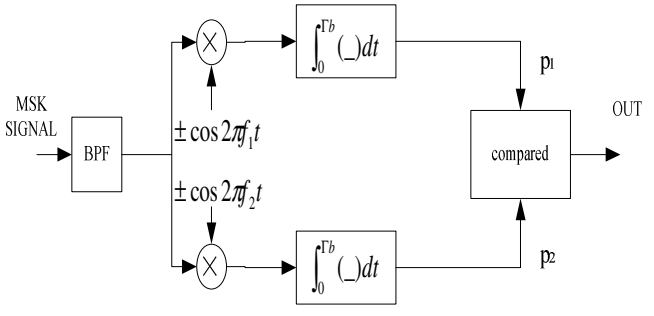

Fig. 1. Flowcharts of the digital demodulation of signal

The Principle of Digitals Processing by DFT

The DFT could be defined as:

$$F(n)=\frac{1}{N}\sum_{k=0}^{N-1} f(k)e^{-t\frac{2\pi}{N}kn},\ 0\le n\le N-1 \tag{1}$$

and its converse transform is defined as:

$$f(k)=\sum_{k=0}^{N-1} F(n)e^{t\frac{2\pi}{N}kn},\qquad 0\le k\le N-1 \tag{2}$$

This transform indicates that the finite sequence $f(k)$ of point N in time domain could be transformed into the finite sequence $F(n)$ of point N in frequency domain. It is assumption that the cosine signal has initial phase ϕ_0, with amplitude A, and frequency f_0. So it could be defined as:

$$f(t) = A\cos(2\pi f_0 t + \phi_0) \tag{3}$$

If rectangle signal with width, T_b ,contains m cycles of the cosine signal, $(m = T_b f_0)$, and is sampled with N points :

$$f(k) = A\cos(\frac{2\pi mk}{N} + \phi_0) \quad k = 0,1,....., N-1 \tag{4}$$

In order to obtain the information of linear spectrum of frequency, f_0, in frequency domain, the DFT could be done for $\{f(k)\}$:

$$F(m) = \frac{1}{N}\sum_{k=0}^{N-1} f(k)e^{-j\frac{2\pi}{N}mk} = I(m) + jQ(m) \tag{5}$$

where:

$$I(m) = \frac{1}{N}\sum_{k=0}^{N-1} f(k)\cos(\frac{2\pi}{N}mk)$$
$$Q(m) = \frac{1}{N}\sum_{k=0}^{N-1} f(k)\sin(\frac{2\pi}{N}mk) \tag{6}$$

The $F(m)$ indicates the amplitude and phasic angle of fundamental wave of sampling value sequence (the whole sequence with m cycles of cosine signal) . [4]The amplitude of the fundamental wave is defined as:

$$A_m = |F(m)| = \sqrt{I^2(m) + Q^2(m)} \tag{7}$$

Digital Demodulation Algorithm of MSK which is Based on the DFT

The signal of MSK is defined as:

$$S_{msk}(t) = A\cos\left[2\pi f_c t + \frac{p_n \pi t}{2T_b} + \phi_0\right] \quad 0 \le t \le T_b \tag{8}$$

where, A is the amplitude of the modulation signal; f_c is the frequency of unmodulated carrier wave; T_b is the space of the binary digit information; $p_n = \pm 1$, determines the binary digit information 1 and 0 separately; ϕ_0 is the original initial phase[5].

The sampling value of one code cycle is calculated twice by DFT and then gets two amplitudes which are relative to two frequency components, f_1 and f_2. The carrier wave component of 1 code is calculated by DFT with sampling sequence of signal code cycle and gets the amplitude A_1 :

$$A_1 = \sqrt{I^2{}_1 + Q^2{}_1} \tag{9}$$

where :

$$I_1 = \frac{1}{N}\sum_{k=1}^{N} f(k)\cos(\frac{2\pi}{N}m_1 k)$$

$$Q_1 = \frac{1}{N}\sum_{k=1}^{N} f(k)\sin(\frac{2\pi}{N}m_1 k) \tag{10}$$

After that, the carrier wave component of 0 code is calculated by DFT once and gets another amplitude A_2 :

$$A_2 = \sqrt{I^2{}_2 + Q^2{}_2} \tag{11}$$

where :

$$I_2 = \frac{1}{N}\sum_{k=1}^{N} f(k)\cos(\frac{2\pi}{N}m_2 k)$$

$$Q_2 = \frac{1}{N}\sum_{k=1}^{N} f(k)\sin(\frac{2\pi}{N}m_2 k) \tag{12}$$

At last, the code could be determined by comparing with two amplitudes. The rule is as follows:

If $A_1 > A_2$,the code could be defined as code 1;

if $A_1 < A_2$,the code could be defined as code 0.

3 Computer Simulation

3.1 Generate MSK Signal

Based on Matlab simulation platform, system simulation is done and MSK signal is generated. The code rate of digital signal is: $1/T_b = 1200\, bit/s$; the carrier frequency of yard 1 Is: $f_1 = 1200Hz$; the carrier frequency of yard 0 is: $f_2 = 2400Hz$;the Sampling frequency is: $8kHz$. Figure 2 is a waveform that intercepted from the simulation[6].

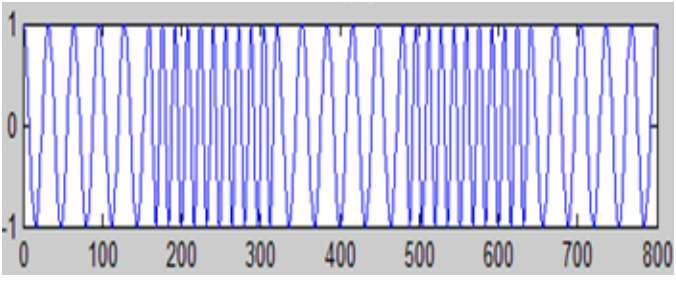

Fig. 2. The signal of MSK

3.2 Generate Caussian

Directly called randn function in MATLAB [7], a random numbers of Gaussian distribution in the length of m can be generated. The simulation system takes the sequence length m is equivalent to MSK signal sampling sequence length. Gaussian noise is shown in Figure 3.

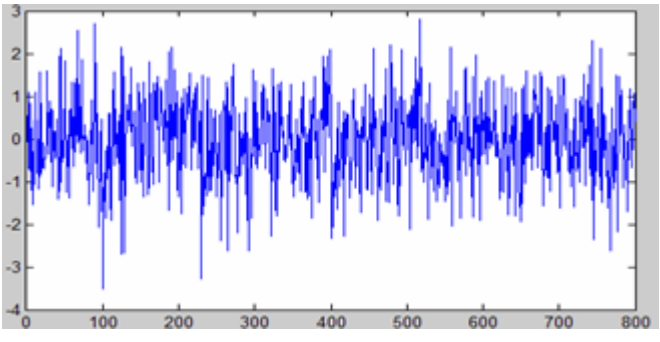

Fig. 3. Gaussian

3.3 The Contrast of Symbol Value

Through the Simulation of DFT-based MSK digital demodulation algorithm, the symbol contrast value before and after signal demodulation can be obtained, as shown in Figure 4. It is the simulation and verification results of 20 symbol simulation. Through the comparison, it is found that the symbol contrast value before and after signal demodulation in this method has high accuracy, and the error is in allowing range.

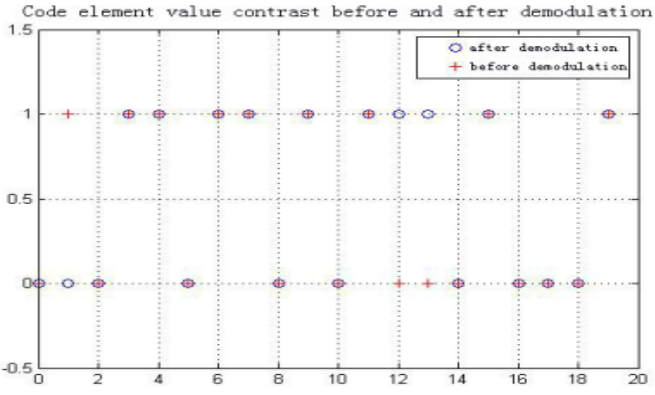

Fig. 4. The contrast of symbol value

3.4 The BER Performance Comparison

Figure 5 shows difference in BER[8] performance under different signal to noise ratio comparison between the MSK demodulation algorithm and the traditional quadrature demodulation. It can be seen from the figure that the bit error rate of DFT-based MSK digital demodulation algorithm was significantly reduced, indicating that the Anti-jamming performance have been significantly improved compared with traditional methods.

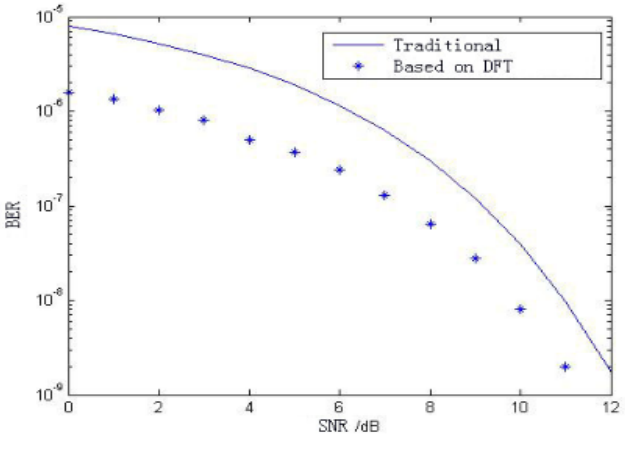

Fig. 5. The BER performance comparison

4 Conclusion

DFT-based algorithm for MSK digital demodulation is to do twice DFT calculations on each sample value of MSK signal code per cycle, to calculate the corresponding yard 1 and yard 0 of carrier frequency amplitude information, according to the size of

the amplitude, thus the digital signal is recovered. Through the simulation validation it can be seen that this algorithm is effective, reduced the amount of calculation, and has the ability to filter noise, and greatly improved the ability against kinds of interference, and can be used in the digital demodulation in ACARS system.

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Defending P2P Networks against Malicious Worms Based on Benign Worms

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Abstract. Malicious worms can be exploited to steal user's privacy information, destroy the user system and launch DDOS attack. We proposed a method of forming secure P2P network using benign worms against malicious worms. The benign worm with a hitlist is used to patch and clean the corresponding malicious worm for peers in the P2P network which is based on the largest distance list. The spread of the benign worm is also a distributed patching process. The patch can be disseminated more quickly and the network congestion is much less than centralized patching scheme in P2P networks. In the experiments, after the benign worm accomplished its mission in the P2P network, almost all of the vulnerable and infected peers are healthy. The P2P network is secure to the malicious worm.

Keywords: P2P network, vulnerability, malicious worm, benign worm, hitlist.

1 Introduction

Most worms observed have appeared actually after the exploited vulnerability has been published on the Internet [1]. An effective method to hold back the propagation of worms is patching. The time between patch release and worm appearance is shrinking. The Witty worm was observed little more than a day after the patch release [2]. Some worms even have appeared before the patch is available, such as the ANI worm [3]. Internet scale infection is possible within minutes. P2P networks provide an ideal venue for new types of worms that prey on common vulnerabilities on the hosts in a P2P network. These worms find new victims simply through P2P neighbor list on infected hosts. They spread much faster than internet worms. After the release of a patch users can download the patch from patch servers. While centralized patch distribution may lead to severe server-side bottlenecks even DOS attack. Many patch distribution methods based on P2P networks have been proposed recently [4-6]. With patch distribution in P2P network, susceptible hosts can request patches from previously patched hosts. Another problem is many users are reluctant or neglect downloading the patch.

To counter the malicious worms some anti-worms such as Nachi [7], Code green [8], CRClean [9] and Welchia [10] have appeared after the malicious worms have caused great damage. But some of those anti-worms had devastating effects because of the overwhelming traffic generated by them. Although the anti-worms have some

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shortcomings, many researchers try to diminish their weak points and control them more strongly [11, 12]. Some researchers utilized the benign worm to counteract the malicious worm [13][14].

We argued that if a peer is vulnerable to a malicious worm it must be invade by a benign worm. So we utilized the benign worm with a hitlist to patch and clean the corresponding malicious worm in a P2P network which has adopted the largest distance neighbor list. Those vulnerable peers in the hitlist resulted from the vulnerability information are target peers which should be cleaned or patched. The dissemination of the benign worm is also a patching process. It is a distributed process which can disseminate the patch more quickly than centralized patching scheme. The infected peers can recover after the benign worm cleaned the malicious one and the vulnerable peers can be patched after this process. Then the P2P network is secure to the malicious worm.

2 Related Work

RapidUpdate[6] is a peer-assisted system which can meet the specific needs of distributing security content. It is able to distribute small files by using central planning and allowing peers to participate fully in the system. They utilized the RapidUpdate client and topology server to implement the system. The topology server can guide a peer who requests a patch to obtain the patch from one of the patched peers.

An active immunization method by the use of an anti-worm was explored [15]. The idea was to transform a malicious worm into an anti-worm which spreads itself using the same mechanism as the original worm and immunizes a host. They proposed architecture to generate an anti-worm. Their current prototype uses an external payload, which has a serious drawback: The extra traffic generated by the downloading of the payload may lead to network congestion. It may also lead to denial of service at the download site. Furthermore, this method can't deal with the malicious worms that closed the backdoor after invading the host.

A new defense policy based on hybrid benign worm named automatic prior tend to high quality nodes (APTHQN) is proposed [13]. The APTHQN policy made use of the topology advantage of high quality nodes and effectively adapted dynamic of P2P network.

In [14] B.Wang etc. proposed a kind of P2P Anti-Worm which propagates using P2P techniques to counter the Internet worms. The P2P anti-worm can slow down the speed of the malicious worm.

We proposed a worm containment scheme based on double-neighbor lists in P2P overlay networks [16]. One neighbor list is based on the largest distance, which is used for normal information transmission. The other is based on the smallest distance, which is constructed when an alert is needed to sent to other peers. A peer can be surrounded by its neighbors who have different vulnerability with it, so that the worm utilizing the vulnerability in the peer can be contained. But there are although many peers are vulnerable to or infected by the worm. Our method in this paper is based on the scheme and releases the benign worm to compete with the malicious worm, and then form a secure P2P network to the worm.

3 Countering Scheme

There is a server which stores the vulnerability matrix and the distance matrix in P2P network [16]. The server selects neighbors for each peer based on the largest distance. A infected peer can be contained by its neighbors. The larger the number of neighbors is, the more infected peers are, because the possibility a peer has the same vulnerability as its neighbors is larger. Those infected peers should be recovered by benign worms. Moreover, there are many vulnerable peers who haven't been infected because the worm didn't reach them. Those peers should be immunized by benign worms to avoid being infected later.

3.1 The Functions of the Benign Worm

The functions of the benign worm include invading the vulnerable peer, cleaning the malicious worm, dividing the hitlist, patching, recording peer information, reporting to the server, self-destructing. The invading module is to probe a peer and invade it. The cleaning module is to kill the malicious worm in a peer. The patching module is to download the patch and install it. The dividing module is to split the hitlist into several parts. The recoding module is to record the information of the peer which the benign worm has passed by. The reporting module is to report the information of the peer which the benign worm has passed to the server. The self-destructing module is to suicide after a benign worm has completed its task in a peer. To decrease the payload of the benign worm self the patch should be external to the benign worm. And the patch can be downloaded from some peer who has been patched with the propagation of the benign worm.

The payload of the benign worm should also include a hitlist which consists of the IP addresses of some peers. The benign worm will try to invade those peers in the hitlist.

3.2 The Mission of the Benign Worm on a Peer

When a benign worm is released at a peer, it first looks for the malicious worm in the peer, as showed in Fig. 1. If it has found a malicious worm, it should clean the malicious worm and then download the patch from the server else it only needs to download the patch. Before the patch is downloaded, the worm sends message to next peers in the hitlist automatically. Then it try to invade them through the vulnerability or the backdoor which the malicious worm left after. The benign worm continue the previous process, but request the patch not from the server but from the previous peer, because the previous peer certainly has the patch which the benign worm has downloaded before.

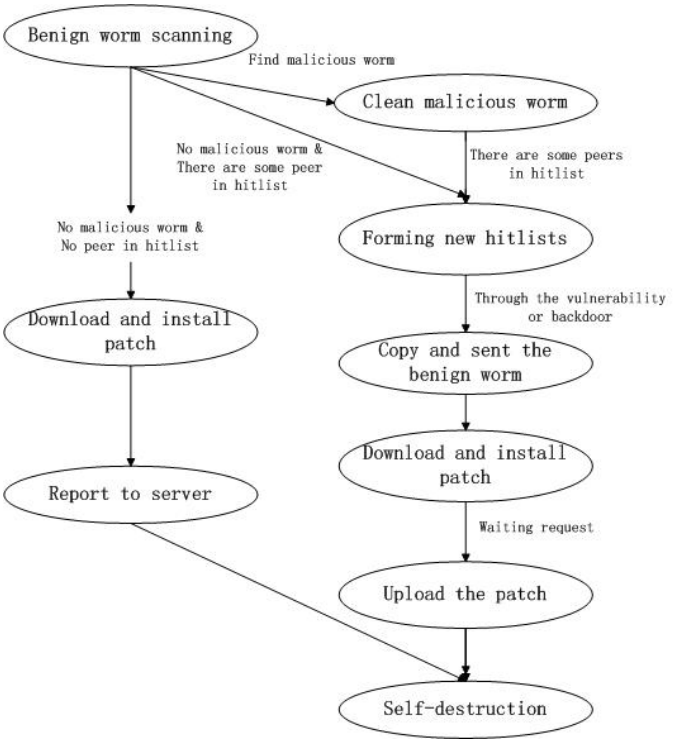

Fig. 1. The mission of a benign worm on a peer

A benign worm should self-destruct after it infected all of its peer's neighbors. If all the neighbors of a peer can't be infected by the benign worm or the hitlist is null, the benign worm should report to the server which peers it passed by before it self-destructs. The peers which the benign worm passed by must be immunized. The server should update the vulnerability information according to the report.

3.3 The Dissemination of the Benign Worm

We assume the benign worm is stronger than the malicious worm on functions because the benign worm is generated after the malicious one. If a benign worm comes across the malicious worm, it can delete the malicious one. After the benign worm invades a peer which has been infected by the malicious worm, the benign worm can clean the malicious one. If a vulnerable peer has been patched by a benign worm, the malicious worm can't invade the peer.

To the known vulnerability the corresponding benign worm should be placed on the server in advance. The hitlist consists of the IP addresses of the peers who are vulnerable to the malicious worm. The patch is downloaded from the official patch server and is placed on the server when the patch has been released. If the patch hasn't been released an instant patch should be generated and placed on the server.

If an unknown worm is captured, the corresponding benign worm can be generated through the malicious worm. And the newly generated worm should run in a virtual machine to ensure it not destroy the host peer.

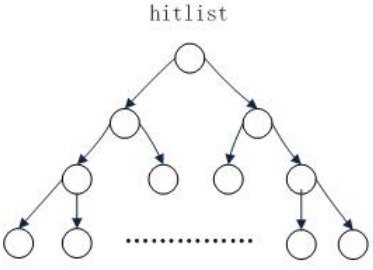

Fig. 2. The process of a hitlist spliting to 2 branches

Once the benign worm generated, the server should select several peers which are vulnerable to the malicious worm to release the worm on them. Then the benign worm disseminate along the hitlist. If the number of the peers which a benign worm wants to infect from one peer is set to 2, then the worm should divide the hitlist except the next two peers into two small equal parts as new hitlists for next peers, as shown in Fig. 2. The benign worm copies its payload including a new hitlist and sent them to a next peer. This process will continue until all the peers of the hitlist are infected by the benign worm. After all the benign worms have reported and the vulnerability matrix is updated, it is possible that there are still some peers who still are vulnerable to or infected by the malicious worm because of the joining and departure of some peers. To clean the malicious worm in the P2P network completely the server should form new hitlist according to the vulnerability matrix and continue the above process until there aren't vulnerable peers in the P2P network.

The dissemination of the benign worm is also an automatic patch obtaining scheme. It is distributed because it avoids using the patch server and topology server and the traffic is dispersed to many different routes simultaneously, almost the vulnerable and infected peers participate in transmitting the patch.

After the process is finished, the whole P2P network is safe and can't be invaded by the malicious worm.

4 Evaluation

Our method of defending P2P network is based on the following assumptions:

An infected peer will send the worm packets to all its neighbors in the overlay network. A neighbor peer will be infected by the malicious or benign worm once it receives the worm packets from an infected peer or the previous peer, if and only if the neighbor is vulnerable to them and not infected. A peer infected by the worm will remain in that state until it receives the benign worm packets from the previous peer and then the malicious worm is cleaned. A peer who is not vulnerable to the worm and who is immunized by the benign worm will not be infected by the malicious worm.

Simulation software we used is peersim1.0.5. In our experiments the initial number of peers is 1000 and the initial number of vulnerabilities is 20. The logical value of each element is generated randomly. The benign worm is released at the same time the malicious worm start to spread.

The first 3 rows in Table 1 show the number of infected peers at every step on the condition of the hitlist is divided into 2 parts called branches, each peer has 9 neighbors and the P2P network includes 1000 peers. Because the vulnerability matrix is randomly generated, the number of vulnerable peers to a worm is about 500. To a network randomly constructed in peersim almost all the vulnerable peers are infected because the number of infected peers is 499. There are 347 infected peers adopting the largest distance neighbor list, that is 152 vulnerable peers are not attacked by the malicious worm. The number of total infected peers on the countering scheme is only 130, that is to say the benign worm reach 217 peers early than the malicious worm. Those 217 peers are immunized by the benign worm.

Table 1. 2 branches & 9 neighbors

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**>9**	**total**
radom	7	30	114	228	104	16	0	0	0	499
largest	2	4	4	4	9	23	35	51	215	347
defending	8	14	21	26	31	23	7	0	0	130
cleaned	0	0	0	0	4	8	36	82	0	130
immunized	1	2	4	8	12	24	28	46	247	372

The data of the 4^{th} row and 5^{th} row in Table 1 are the number of the cleaned and immunized peers at every step on the condition of the hitlist is divided into 2 parts. All the infected peers are cleaned by the benign worm. The cleaned and immunized peers are those peers the benign worm passed by. The number of those peers is 502, which means almost the vulnerable peers become to not vulnerable to the malicious worm. The whole P2P network is secure to the malicious worm.

We vary the number of branches to 2,3,5, and keep the number of neighbors on 9. The trend to the number of infected peers, cleaned peers and immune peers is shown in Fig. 3. The bigger the branch number, the fewer the infected peers are, the faster the benign worm spreads. The dissemination of the benign worm restrains the spread of the malicious worm. The cleaned peers are decreased with the branch number increasing as well. Contrarily the immunized peers increased with the branch number increasing, because some vulnerable peers haven't infected by the malicious worm due to the benign worm spreading faster than the malicious worm.

We vary the number of a peer's neighbors to 5,7,9, the trend of the number of infected peers as shown in Fig. 4. If the number of neighbors is 5, the infected peers are fewer because of the largest distance neighbor scheme. But if the number of neighbors is 9, more peers are infected. Finally those infected peers are cleaned by the benign worm of course.

The experiments show that all the infected peers are cleaned and almost the vulnerable peers are patched. That is the P2P network is secure. Several vulnerable peers can't affect the security of the whole P2P network.

5 Conclusion

We proposed a defending scheme to protect P2P networks against the malicious worm through the benign worm cleaning the malicious worm at infected peers and immunizing the vulnerable peer. The P2P network is based on the largest distance neighbor list. The propagation of the benign worm is along the included hitlist which resulted from the vulnerability information. The spread of the benign worm also is the automatic patching process which is a distributed patching scheme in the P2P network. On the basis of the largest distance neighbor list using benign worm to defend P2P network is an effective method. The experiments demonstrate that our method is forceful.

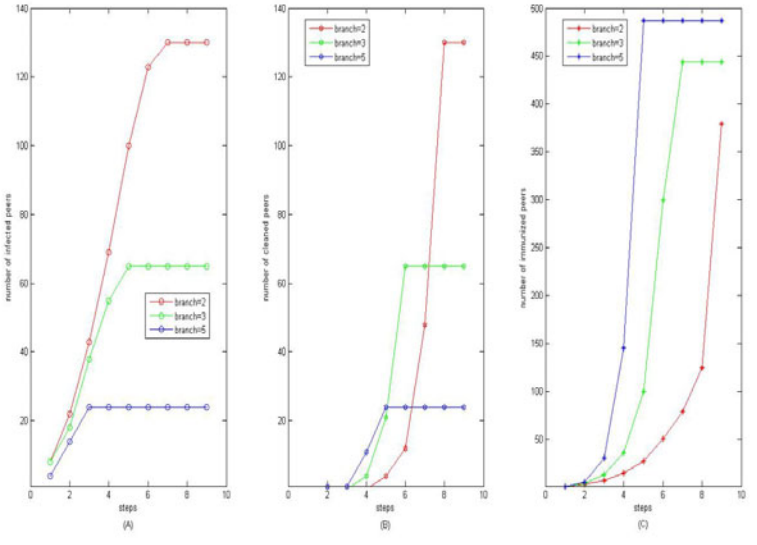

Fig. 3. Varing the branch number to 2,3,5

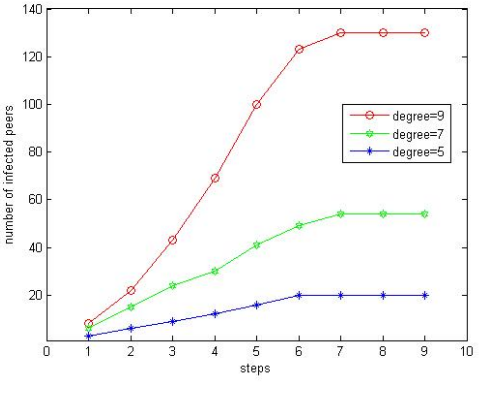

Fig. 4. Varing the number of a peer's neighbors to 5,7,9

6 Further Work

In future we will do our best to improve the controllability of the benign worm. We want to implement a real system based on this method and deploy it on an unstructured P2P network.

Furthermore, the technology of the benign worm generation is imperfect now. We plan to utilize symbolic execution to analyze the malware code and generate benign automatic programs with higher functionality.

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Analysis and Simulation of Slot Collision and Reception Performance of AIS

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Abstract. Time division multiple address and dynamic slot reservation selection method are adopted in automatic identification system (AIS). In the actual communication system, base station and ships can't know the communication performance like throughput of the whole system. Especially under high data link load condition, the multi-users conflicts may occur, which brings difficulties to the dynamic monitoring of the ships. Therefore, this paper analyses the reception performance of base station especially under the condition of multi-users conflicts in the system. Through computer simulation, the throughput, failed reception ratio and slot wasted ratio of the AIS system can be obtained under different channel load. The results can be used in optimization information broadcasting of base station and optimization the AIS network.

Keywords: AIS, SOTDMA, slot collision, Channel Load, Throughput.

1 Introduction

The Automatic Identification System (AIS) is new navigation system, which is equipped on the vessels, based on the VHF, GPS and other communication techniques. AIS will lead the VTS (Vessel Traffic Service) to an automatic and intelligent age. At the same time it can also improve the management of vessels and ensure the safety of navigation [1].

SOTDMA (Self-Organized Time Division Multiple Access) is the key technique in AIS. It is a new communications technology used for navigation and air traffic management which is based on TDMA [2]. One frame of AIS information occupies one minute and is divided into 2250 time slots. One slot equals 26.67ms [3]. Every ship in the system broadcasts its navigation information and reservation information of time slots periodically. All ships and basic stations collaborate to provide a self-organized slot reservation table respecting all reservations during transmissions.

SOTDMA is of great significance to identify ships dynamically and improve the safety of maritime navigation [4]. However, with the increase of the number of ships, there is more information that needs to be transmitted through the AIS vessel data link. Because of the overlapping of candidate slots, there may be more than one ship reserve the same time slot. This may bring slot collisions, which brings risk to the safety of navigation. Under the condition of high channel load, this slot collision may

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occurs in two or more users, which may makes all of the users are not recognized and results in a waste of time slots. Based on the computer simulation, this paper will analyses the slot collision and reception performance of base station, establishes simulation models, and gives the simulation results.

2 Modeling and Analysis of Slot Collision

In AIS, SOTDMA protocol is used to resolve the problem of communication conflict without any control by the base station [1]. The coverage radius of most base stations is 30-40 nautical miles. In this distance range, the affect of error rate is small in general marine conditions, which can be neglected. Thence, the main influence factor of throughput is the slot collision in the process of users reserving time slots. The slot collision can be divided into two conditions as follows. On the one hand, there may be slot collision when the users are not complete self-organized. We call this outside-group slot collision. On the other hand, the slot collision may occur when more than one users reserve the same free slot at the same time. We call this inside-group slot collision. Then, we will analysis the two conditions of slot collision in detail.

A. Analysis of Outside-Group Slot Collision

In the actual communication system each station works independently from each other [5]. Suppose radius of all the stations is R, the distance between two stations is d. Fig.1 shows a communication system model between two stations. The shaded area represents the public coverage of the two stations. We can say that all the users in the shaded area can communicate with the station A and station B at the same time, while the users in other area can communicate with the only one station. With the decrease of d, the two stations begin to organize once d equals to R, and we can consider that their organization is more and more stronger. Only when d equals zero, the two stations can organize completely.

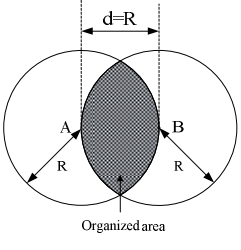

Fig. 1. Communication system model between two stations

Fig.2 shows the principle of outside-group slot collision. Suppose M users in the coverage of the station Rx distributed uniform. Assume the coverage radius of the base station equals to that of the users. There is a ship Tx applying for time slot. Obviously, the station Rx and the ship Tx are not complete self-organized, so the ship Tx can't see the ships in the shaded area as Fig.2 shows. Therefore, when the ship Tx

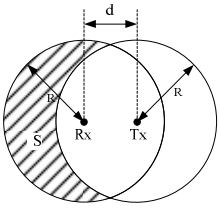

Fig. 2. The schematic of outside-group slots collision

apply slot, it may choose the slot as free slot which has occupied by other ships in the shaded area already. Then, outside-group slot collision occurs.

B. Analysis of Inside-Group Slot Collision

In the high-density traffic maritime space, with the overlapping of the signals coverage area, it is possible that more than one ship apply the same slot at the same time. On the other hand, under the condition of high channel load, one or more users may still apply the slot in the condition of knowing it has been occupied already. Then the slots collision occurs which we called inside-group slot collision. This phenomenon usually occurs when the channel load beyond the system capacity of the AIS network.

Previous papers focus on analysing the collision between two users, however, in the actual communication AIS system, collisions often occur among more than two users. This paper will analyses the reception performance of base station in the condition of multi-users conflict.

C. The Reception Performance of Base Station in the Condition of Slot Collision

Suppose there are two transmitters T_{X1} and T_{X2}, and a receiver Rx which is R_1 apart from transmitter T_{X1} and R_2 apart from transmitter T_{X2} . There will be three reception statues in the condition of communication collision. (a) Receive transmitter T_{X1}'s data accurately. (b) Cannot receive the data of any transmitter. (c) Receive transmitter T_{X2}'s data accurately. The first and the third statues are the recognition status, while the second status is the confusion status. The confusion status is that the receiver cannot receive the data of two or more users which conflict in the communication, while the recognition status is that the receiver can receive the data of one user among the users which conflict in the communication. The reuse slot is still a valid slot in the recognition status, but an invalid slot in the confusion status. That is, the reuse slot is wasted in the confusion status.

According to the electromagnetic field theory, whether receiver can receive the data of transmitters depend on their received power ratio from the receiver [6]. According to the theory of transmission loss of electromagnetic wave in free space, when the ratio of R_1 and R_2 is more than or equals to 1.31, conservatively more than or equals to 2, the receiver can receive the data of transmitter T_{X2} accurately.

Extending to the case of multiple transmitters, suppose r users in system transmit data using the same slot at the same time, which lead to slots collision. According to the theory of transmission loss of electromagnetic wave in free space, the relation between the received power P_R and the transmitted power P_T is

$$P_R = G_T G_R P_T \left(\frac{\lambda}{4\pi R} \right)^2 \tag{1}$$

Here G_T is the antenna directive gain of transmitter, G_R is the antenna gain of receiver, R is the distance between the transmitter and receiver, λ is the wavelength.

According to ITU requirements, AIS system works in 150MHz frequency band, and the transmitted power is divided into two kinds of 2W and 12.5W[7]. The received gain channel equals to the transmitted gain channel which expressed by 'G'. So we can simplify (1) as

$$\begin{aligned} P_R &= G^2 P_T \left(\frac{\lambda}{4\pi R} \right)^2 \\ &= G^2 P_T \lambda^2 \frac{1}{(4\pi)^2} \frac{1}{R^2} \end{aligned} \tag{2}$$

Defining $A = G^2 P_T \lambda^2 \frac{1}{(4\pi)^2}$, we can get the received power as

$$P_R = \frac{A}{R^2} \tag{3}$$

When the slot collision occurs among r users in system, we suppose P_1 is the received power of the user which is the nearest to receiver (base station), while the superposition received power of other $r-1$ users is $\sum_{i=2}^{r} P_i$. The distances between the receiver and r users are R_1, R_2 ,…, R_r, and R_1 is the nearest one. According to the theory of transmission loss of electromagnetic wave in free space, we can draw the conclusion that if the condition (4) is met, the receiver (base station) can receive the nearest user's data accurately.

$$\begin{aligned} \sqrt{\frac{\sum_{i=2}^{r} P_i}{P_1}} &= \sqrt{\frac{A\left(\frac{1}{R_2^2} + \frac{1}{R_3^2} + \cdots + \frac{1}{R_r^2} \right)}{\frac{A}{R_1^2}}} \\ &= \sqrt{R_1^2 \sum_{i=2}^{r} \frac{1}{R_i^2}} \\ &= R_1 \sqrt{\sum_{i=2}^{r} \frac{1}{R_i^2}} \le \frac{1}{2} \end{aligned} \tag{4}$$

Consequently, apart from the influence of sudden disturbance, we can say the base station can receive data accurately as long as there is no slot collision. However, based on the distance from the base station, part of users in slot collision which is nearer to base station can also be received by station accurately. We suppose the number of time slots occupied by this part of users is N_{bi}. Then the number of successfully transmission slots N_o is:

$$N_o = N - N_k + N_{os} + N_{bi} \tag{5}$$

Here N_k is the number of free slots, N_{os} is the number of successfully occupied slots among free slots.

Then the utilization ratio P_o is:

$$P_o = \frac{N_o}{N} \times 100\% \tag{6}$$

The throughput of the system is the ratio of the number of successfully transmission slots and the number of the total slots.

3 Simulation and Results Analysis

In this section, neglecting the influence of error rate, we analyse the reception performance of base station under different data link loads when there has communication collision.

A. Simulation of the Received Performance of Base Station

Now we define the number of time slots in one frame in the system model is N, and the number of all the users within the coverage area of base station is M. Suppose M users apply time slot randomly, and add to the system gradually until the system reach a dynamic balance status. That is, at any time there are a part of users applying the time slots, while the other part of users occupying their time slots which will be released after a certain time-out. Since the random time-out of each time slot is 3-7 frames, the average time-out is 5 frames. Then, we can divide the all users into five groups macroscopically. Therefore, at any time there are $\frac{4}{5}M$ users occupying their time slots which include the successful occupying and reused occupying, and $\frac{1}{5}M$ users applying time slots. Then, base on the computer simulation, we can analysis the performance of the communication system. Fig. 3 shows the simulation of how users apply time slots in groups in the AIS system model.

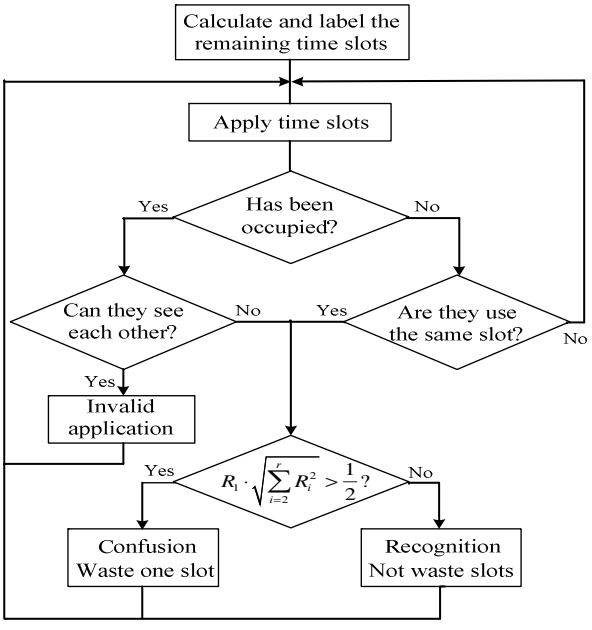

Fig. 3. Simulation flow chart of applying slot

B. Analysis of the Simulation Results

Based on the computer simulation, the simulation result of the reception performance of base station is shown in Table 1. Based on the simulation results the communication system performance will be analyzed in detail as follows.

Table 1. The simulation result of the reception performance of base station (unit: %)

M	CMI	CMO	CM	FR	TR	p
5	0.32	0.65	0.97	2.37	97.63	4.96
10	0.41	1.01	1.32	3.91	96.09	9.92
15	0.60	1.29	1.89	5.50	94.50	14.89
20	0.98	1.75	2.73	7.22	92.78	19.82
25	1.41	2.28	3.69	9.07	90.93	24.67
30	1.79	2.92	4.71	11.04	88.96	29.31
35	2.37	3.49	5.86	13.05	86.95	34.29
40	2.91	4.20	7.11	15.73	84.27	39.20
45	3.40	5.03	8.43	18.19	81.81	43.71
50	4.09	5.73	9.82	20.76	79.24	48.16
55	4.76	6.57	11.33	23.52	76.48	53.33
60	5.42	7.59	13.01	26.35	73.65	58.00
65	6.27	8.52	14.79	29.42	70.58	62.78
70	6.99	9.64	16.63	32.64	67.36	67.09
75	7.86	10.61	18.47	35.97	64.03	71.87
80	8.62	11.62	20.24	40.31	59.69	76.78
85	9.37	12.66	22.03	45.09	54.91	81.02
90	10.14	13.69	23.83	50.13	49.87	85.40
95	10.96	14.66	25.62	55.19	44.81	89.64
100	11.81	15.76	27.57	60.23	39.77	94.84

Here M is the ratio of the number of users in system and the number of total slots in one frame; CMI is the ratio of the number of wasted slots in inside-group slot collision confusion and the number of total users in system; CMO is the ratio of the number of wasted slots in outside-group slot collision confusion and the number of total users in system; CM is the number of all wasted slots in slot collision and the number of total users in system; FR is the ratio of the number of cannot identified users caused by slot collision and the number of total users in system; TR is the throughput of system, that is, the accurately identified ratio; p is the channel load of system.

The base station can identify the channel load of system, but cannot identify the information including the number of wasted slots, the collision confusion among users and the throughput of system. By fitting the minimum mean square error, for the channel load p, we can get the model of the confused slots reused ratio of base station CM , failed reception ratio of base station FR and the throughput in system TR as follows.

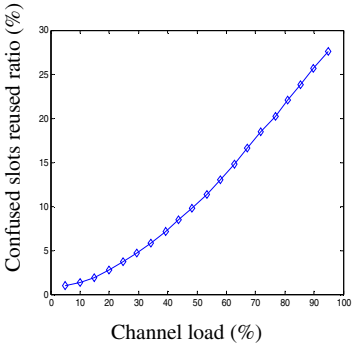

Fig. 3. The ratio of confused slots and the number of all users

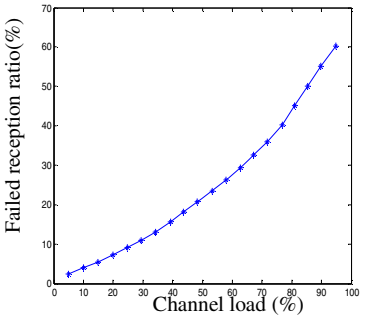

Fig. 4. The failed received slots and the number of all users

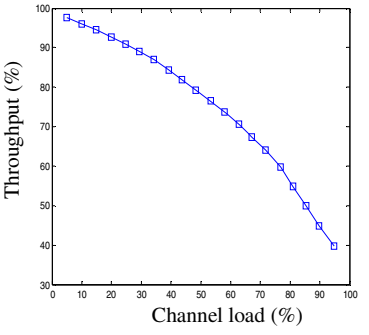

Fig. 5. The throughput under different channel load

It can be seen from table 1, Fig.3 and Fig.4 that relative to the total number of users in system, when the channel load is about 20%, the wasted slots caused by collision is under 5%, the failed received slots is less than 10%, and the throughput in system is exceed 90%; when the channel load is about 60%, the wasted slots caused by collision is about 15%, the failed received slots is about 27%, and the throughput in system is about 72%; while the channel load reaches 90%, the wasted slots caused by collision is about 25%, the failed received slots reaches 55%, and the throughput in system reduced to 45%. Then we can build the model of slot wasted ratio, failed reception ratio of base station and the throughput under any channel load as follows by fitting the curve in the Fig.3, Fig.4 and Fig.5.

$$CM = 0.0020p^2 + 0.1121p - 0.0910 \tag{7}$$

$$FR = 0.0051p^2 + 0.1209p + 2.5787 \tag{8}$$

$$TR = -0.0051p^2 - 0.1209p + 97.4213 \tag{9}$$

4 Conclusion

AIS equipped on ship is playing an important role in vessel traffic service. Based on the analysis of the communication protocol SOTDMA, this paper simulated the slot occupied process which multi-users conflict is taken into account. Based on the computer simulation, we build the model of slot wasted ratio, failed reception ratio of base station and the throughput under any channel load. The results of the study may provide a theoretical basis in providing more rapid and more accuracy aid navigation service and optimization of the AIS network.

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Changes in Spectral Reflectance of Vegetation in Response to Specific Nutrient Supply*

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Abstract. The nutritional status of the vegetation were typically evaluated through field sampling and laboratory analysis, but might also be assessed by remote sensing technology, especially on a regional level. Abnormal nutritional status of vegetation could induce changes in biochemical composition, and physiology of plants, which subsequently influenced vegetation spectra. In this paper, changes in spectral reflectance of plants in response to specific nutrient such as nitrogen, phosphorus and iron supply were discussed.

Keywords: spectral reflectance, vegetation, nutrient supply.

1 Introduction

Nutritional elements which were needed for the vegetation growth included constant elements, such as nitrogen, phosphorus, potassium, and trace elements iron, sulphur, magnesium and manganese. The nutritional status of the vegetation were typically evaluated through field sampling and laboratory analysis [1], but might also be assessed by remote sensing technology, especially on a regional level (Fig.1). The emission or reflectance characteristics of plants spectra were closely related to health status, water content and pigment content of plants (Fig.2). Abnormal nutritional status of vegetation could induce changes in biochemical composition, and physiology of plants, which subsequently influenced vegetation spectra [2]. Thus, vegetation remote sensing technology, as an environmental real-time monitoring approach [3], has been applied to investigate the relationship between vegetation spectra and nutritional status of the vegetation [4].

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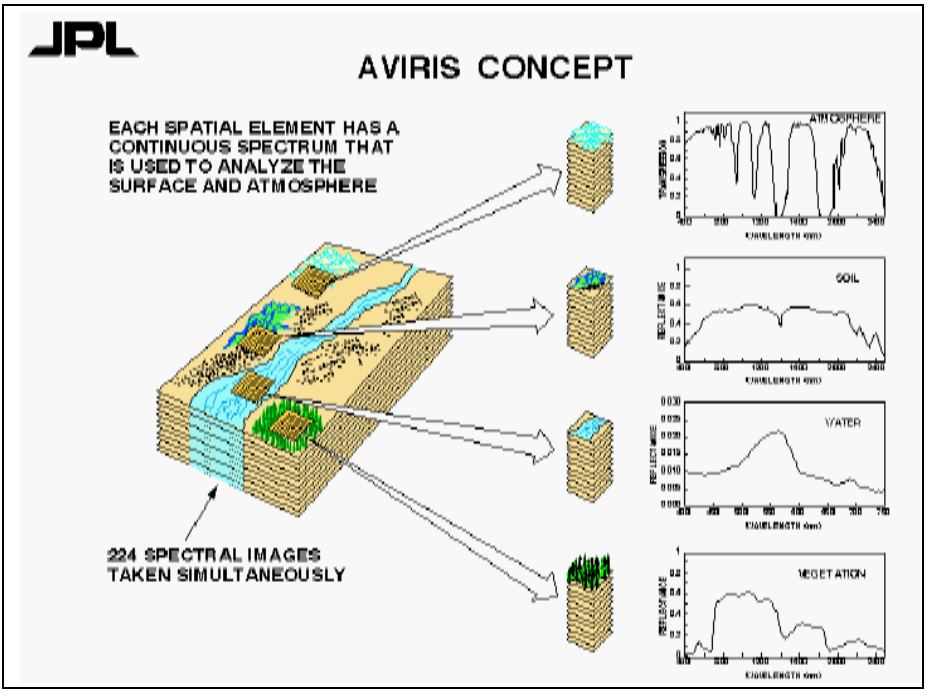

Fig. 1. The graph for hyperspectral Remote Sensing (http://blog.csdn.net/Findback/archive/2007/06/08/1644777.aspx)

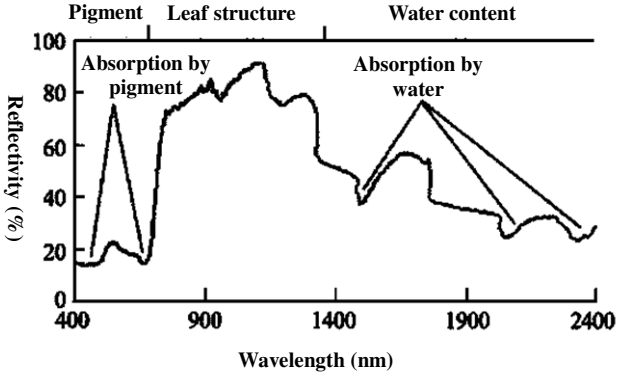

Fig. 2. The curve of typical green plant leaves spectral reflectance

2 Changes in Spectral Reflectance of Vegetation in Response to Nitrogen Supply

Nitrogen management is a key issue in sustainable vegetation production. Nitrogen deficiency would decrease area [5], photosynthesis [6] and chlorophyll content of plant leaves which would make an impact on spectral characteristic of plants. Zhao et al [7] found that leaf spectral reflectance, especially in visible and red-edge regions, was very sensitive to sorghum plant nitrogen status. Nitrogen deficiency could increased leaf reflectance at 555 and 715 (±5) nm. Changes in leaf reflectance at these spectral regions were mainly because of either nitrogen or chlorophyll level of leaves. Blackmer et al [8] and Thomas and Oerther [9] suggested that light reflectance near 550 nm was best to detect N deficiency. Walburg et al [10] showed that nitrogen-deficient corn canopies had increased red reflectance. Stone et al [11] demonstrated that plant nitrogen could be estimated using spectral radiance measurements at 671 and 780 nm [12]. Shibayama et al [13] had studied the impact of nitrogen on spectral characteristic of the paddy rice. They found that chlorophyll was the major factor which caused the diversity of spectral characteristic. In addition, Masoni et al [14] also pointed out vegetation which lack nitrogen element would result in changes of chlorophyll content and the leaf spectral characteristics.

3 Changes in Spectral Reflectance of Vegetation in Response to Phosphorus Supply

Phosphorus was a key macronutrient absorbed by vegetation mostly in the monovalent orthophosphate form $H_2PO_4^-$. It participated in some of the metabolic processes of plant in a variety of ways included photosynthesis [15]. Chlorophyll content may increase in mild phosphorus deficiency and the leaf spectral analysis can be used in phosphorus diagnosis. The effects of phosphorus on plants characteristic spectrum were complicated. Because phosphorus deficiency had more effects on plant leaf cells elongation than chlorophyll synthesize. Chlorophyll content per unit of leaf area was increase, and leaves became dark green. Moreover, the carbohydrate metabolism of phosphorus deficient plants was inhibited, so that sugar accumulated and anthocyanins could easily synthesize [16-18]. Therefore, spectral characteristics of phosphorus deficient plants leaves were affected by both chlorophyll and anthocyanin, which resulted in the complexity of plant spectral changes.

While Li et al [19] found that no difference was found in chlorophyll content between phosphorus deficiency and control plant. Although there was marked decrease in leaf phosphorus content, levels did not fall below critical threshold levels when phosphorus supply was withdrawn within the one week period. Long time exposure to phosphorus deficit conditions would be needed before plants enter into phosphorus-stressed state. Future studies might also be geared towards spectral analysis older mature leaves since phosphorus was comparatively mobile and deficiency symptoms would likely occur initially in older tissues.

4 Changes in Spectral Reflectance of Vegetation in Response to Iron Supply

Iron was an essential micronutrient for plant growth, which promotes the absorption of other nutrient elements by plants [20-21] and was crucial to electron transport, photosynthesis, and respiration in the process of plants growth. Chi et al [22] point out that the regulation effects of iron should be considered besides nitrogen and phosphorus during the treatment of eutrophication lakes process. They applied tentatively algal spectral properties under different iron-supply would be in early-warning mechanism of eutrophication lake base on the iron hypothesis. Classic algal in eutrophication lakes were screened to approach the effects of algal growth and spectral characteristics, and defined the spectral-response mechanism of algal under different iron-supply by indoor modeling and field monitoring. Furthermore, in order to reflect the contents and distribution characteristics of iron in lakes truly and timely, the relevant relational model for "iron concentrations in water body-iron contents in algals-spectral characteristics of algal" which could direct the remote sensing monitoring was developed. This study were meaningful for determining the relationships between water bloom and iron, clarifying the dynamic process of algae bloom and developing the remote sensing warning system of lake eutrophication.

Chi et al [22] found that with the increase of Fe^{2+} in a culture solution, the iron content in rice plants increased, while the chlorophyll concentration in vegetative leaves decreased. The spectral reflectivity of vegetable leaves increased in the visible light band but decreased in the near infrared band, and the blue-shift range of the red edge curve increased.

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Research on Access Control during Search Encrypted Data

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Abstract. As cloud storage becomes prevalent, more and more sensitive data is stored in the cloud storage system. In order to protect data privacy data always encrypted stored, which makes effective data utilization a very challenging task. In this paper we first introduce the concept of cloud storage, and the architecture of cloud storage. Then we introduce three classic encrypted data search methods: Linear search algorithm, security index method and then public key encryption with keyword search. Above these, we discuss three searching encrypted data approaches that can used in large cloud storage environment supported access control. These approaches are IPU (Index-Per-User), CSI (Central-Single-Index) approach, and RBAC (Role-Based-Access-Control) approach. And then we analyze both the advantage and disadvantage of these approaches about both the performance and security.

Keywords: Access Control, Encrypted Data Searching, Cloud Storage.

1 Introduction

Cloud computing has received more and more attentions from both the commerce and academic world in the recent years. Cloud computing provides a new model of managing computing resource. Rental Virtual computing resources inside of buying real hardwires and managing them. At the same time, with the development of computer and communicate technology, the total number of enterprise's digital data growing at alarming rate. According to the survey, it doubled every eighteen months10, and because of business and the security or the other requirements the data will be stored more long time than before as well. This caused overwhelming force on enterprise data storage. One way to relieve this pressure is cloud storage which is much well known as Storage as s Service, in this model, enterprise use the external SSP (Storage Service Provider) for digital resource storage. To protect data privacy and combat unsolicited accesses, sensitive data has to be encrypted before outsourcing 2. However, for the delay time of network and the economic interests (for example, many SSPs charge the amount according to the total access data), the users tend to download related documents than download all files. Thus, keyword search

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for files stored at the SSP would be a valuable service to an enterprise. In enterprise data search unlike one user environment, access control is even more important.

In this paper, we first induce the cloud storage in the second part, and then the data search technology in cloud data searching in part three. Then discuss access control approaches, when we search the data we need in the fourth part. At last, we will look to the future work we should do in this area.

2 Cloud Storage

Now, there are many storage service providers such as Amzon S3, Niranix CloudNAS, Microsoft SkyDrive etc.

Cloud storage is a new concept that extends and develops from the cloud computing. Cloud storage congregates different kinds of storage devices though cluster application, network technology, distributed file system, etc. to provide external data storage and business access functions1. The key technologies of cloud storage include Storage virtualization, data organization security, data migration security and so on. Thanks to the development of computer network technology, web2.0 technology, virtualization, data encryption and storage network, cloud storage is develop fast in the recently years. Cloud storage provides storage services through network and compare with traditional storage methods, cloud storage is cheaper, higher reliability, and has more advantage in disaster recovery.

Cloud storage is a hierarchical design. The architecture of it from bottom to upper is network and storage infrastructure, storage management, storage overlay, service interface. The detailed functions will be discussed following.

Network and storage infrastructure is composed by the basic hardware such as storage device, network device.

Storage management, in this layer, geographical distributed storage resources are organized by domains and logical entities.

In storage overlay layer, the virtualization and service retrieving and redirection can be fulfilled. It may be thought as middleware which links storage devices distributed to a virtual storage networks and expose simplified and standard data structures to service interfaces.

In service interface layer, the cloud storage system provides clients uniform interface to access, and filter the illegal clients out of the system. We require all data to be indexed within a trusted enterprise domain before it is encrypted and stored at SSP.

3 Encrypted Data Search in Cloud Storage

In order to solve the problem of data privacy protection in cloud storage, the usual way is to encrypt the data. But when the data stored in cloud reaches a large size, retrieve encrypted data is becoming urgent demand. There are some methods for encrypted data search.

In 2000, Song, Wanger and Perrig3 presented two methods of searching encrypted data, which are Linear Scan and Encrypted Index method. Security index method was

presented by Goh in 20034 which uses Bloom Filter. And then Public key encryption with keyword search5 was presented in 2004. In the following we will introduce these three encrypted search technologies.

In Linear search algorithm, first with a symmetric encrypted algorithm encrypt the pain text. For each key word corresponding cipher text, generate a pseudo-random sequence that the length less than the length of cipher text information and generate a check sequence determine by pseudo-random sequence and the cipher text information. The length of the pseudo-random add to the length of check sequence is equal to the length of cipher text information. Then use the pseudo-random sequence and check sequence to encrypt the cipher text again. When a user query, he submit the cipher text sequence, then sever add modulo 2 linearly to the cipher text information. If the result satisfy the Calibration relations, express the cipher text is exist.

Public Key Encryption with Keyword Search, there are four main polynomial time randomized algorithms. They are KeyGen(s), PEKS(Apub, W), Trapdoor(Apriv, W), and Test(Apub, S, Tw). KeyGen(s) which used to generates a public/private key pair Apub, Apriv. PEKS(Apub, W) is used to produce a searchable encryption of W. Trapdoor(Apriv, W) used to produce a trapdoor Tw. Test(Apub, S, Tw), according to public key, a searchable encryption S= PEKS(Apub, W'') and a trapdoor Tw, outputs 'Yes' if W=W' and 'No' otherwise. This approach is often used in the system like e-mail service.

A secure index is a data structure that allows a enquirer with a "trapdoor" for a word x to test in O(1) time only if the index contains x. Secure indexes are a natural extension of the problem of constructing data structures with privacy guarantees such as those provided by oblivious 7 and history independent8 data structures. The mechanism is that the keys used in each encrypted are created by a group of pre-generated sequence of inverse Hash, and encrypted indexes is put to Bloom filter. While query a word, first create some trapdoors by the inverse hash sequence, and then detect Bloom. At last decrypt the returned cipher texts. Documents are which we required. It is good for multi-user encrypted information searching. However, it needs to create large number of key sequence and with the increase of the searching, adding one more search, the average computational complexity increases linearly. That is hard to accept in enterprise application.

The encrypted search approaches mentioned above are all base on Boolean model. How to rank the query results, and can we use vector space model to solve results ranking problem that are open questions.

4 Access Control in Encrypted Data Search

When we search the encrypted data, how can the system ensure that the data are searchable for us? Access control must be enforced, even during data search. Access control is particular important when the enterprise stored data in the SSPs. Enterprise environment, where there are a lot of users and the users have different permissions, and not all data is accessible to all the users. When we search files, a user should not access the data outside its authority, nor can according the returned results calculate the information that he should not known. The following we will discuss some

approaches used in the access control when we search the encrypted data. In all these approaches, indices should be created before encrypted.

A. IPU (Index-Per-User) approach

This approach is common in the desktop search tools such as Google Desktop Search. Each user has a separate index for accessible files, with duplication for files that are shared with other users 9. The option flow chart can see in fig1. This ensures each user has an index created only from the data that was accessible to that user. These indexes can be securely stored at the SSP(Storage Service Provider) with each index a unique symmetric key made available only by that user.

However, this access control approach increases the cost of additional disk. For example, when the number of users can access file F is N, and the size of indices of F is I, for file F additional storage space $(n-1)*I$ is taken. And when we update file F, it may cause update to N indices. In cloud storage, where N could be in hundreds or thousands or even more, such costs can be prohibitive.

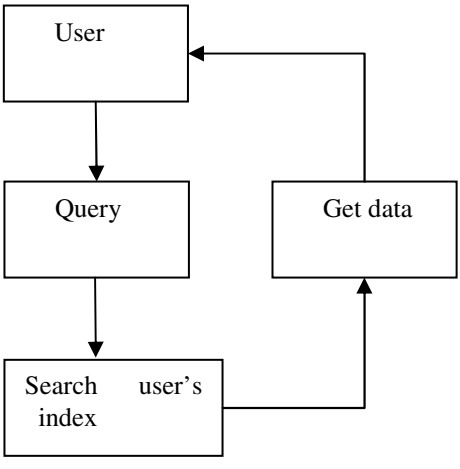

Fig. 1. IPU option flow chart

B. CSI (Central-Single-Index) approach

This approach is often used in enterprise search products, like Google Enterprise Search. The first step of this approach is creating a system-wide index. When user searching, first query the system-wide index that stored in the cloud storage system, the result is filtered based on access privileges of the querying user. This approach provides maximum space and update efficiency. However, because of overall system has only one index, an attacker through craft query can obtain some information that he/she should not known such as the number of files that contain a certain keyword.

In a traditional UNIX-like file system access to a file is governed only by the file's permissions, but also by the hierarchy of permissions of all of the directories above it. So query option in this system execute can be very slow, for check the privileges the system will traversal the directories. The traversal of a directory hierarchy can be

expensive, especially in the case of cloud storage environment where files are distributed to different nodes.

C. RBAC(Role-Based-Access-Control) approach

RBAC according to the latest NIST RBAC6, the basic concept is that users and permissions are assigned to roles and users acquires permissions by being members of roles. A user can belongs to different roles and a role can also contain different users. It is a many to many relationship. The role of the user assigned by the system administrator, and permissions can't transfer. In this approach, each role creates an index for all files that all users belong to this role can be accessed. During querying, system checks the role that user belongs to, and only search the files that the roles have access permissions. Since the introduction of roles, relationship between users and authority is insulated. Compared with IPU approach, the cost of update a file is much cheaper. And this method proved to be "neutral policy", and can archive secure access requirement based on least privilege policy.

However, when the data stored in cloud becoming very large, accompanying with this the roles in the system will become very complex. A user may belong to many different roles. In this situation, some permission of these roles is conflicted easily. For example, role A has read permission in file F, but role B doesn't has read permission in file F, and user U belongs to both roles. Then conflict will happen.

5 Conclusion

In this paper, first we introduce some concept about cloud storage in the second part, and then we introduce some methods of searching encrypted data in the third part. Based on these, we discuss three methods of access control at last in part three.

The main advantage of IPU is it is easy to implement, the disadvantage is IPU is inefficient when we update files. CSI compared with IPU, it is efficient but hard to execute access control and unsafe. RBAC, it is the middle of CSI and IPU, the biggest problem of this approach is conflict control may be complex when the storage size becomes large.

Acknowledgment. The preferred spelling of the word "acknowledgment" in America is without an "e" after the "g." Try to avoid the stilted expression, "One of us (R. B. G.) thanks …" Instead, try "R.B.G. thanks …" Put sponsor acknowledgments in the unnumbered footnote on the first page.

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Optimum Length of Fiber Coil in Space-Borne Interferometric Fiber Optic Gyroscope*

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Abstract. The choice of fiber length in sensing coil is a key issue for interferometric fiber optic gyroscope (IFOG) design. Considering the influence of radiation-induced attenuation (RIA) in fiber, the performance of IFOG will not always improve with increasing fiber length. In order to select a reasonable fiber length, a mathematical model describing the evolution of IFOG's random walk coefficient (RWC) as a function of the fiber length was developed firstly. Then simulation on the behavior of RWC versus fiber length at different fiber's RIA was performed. The results indicate that there is an optimum length of fiber coil in space-borne IFOG at a certain RIA of coil fiber. The optimum length decreases with increasing RIA in fiber, and the corresponding RWC decreases with decreasing RIA. Thereby, a method to optimize the length of fiber coil in space-borne IFOG was proposed.

Keywords: IFOG, optimum length, fiber coil, random walk coefficient, radiation-induced attenuation.

1 Introduction

Interferometric fiber optic gyroscope (IFOG) is a kind of rotation sensors that can be used for positioning, attitude control, and absolute direction measurement. They are considered for space use for advantages like no moving parts, rugged, all solid state construction, high sensitivity, low power consumption, and light weight [1,2]. It is well known that the performance of IFOG could be improved by increasing the fiber length of coil. However, space radiation effects on optical components can deteriorate the performance of IFOG, of which the most prevalent is the radiation-induced attenuation (RIA) in fiber coil, which leads to a decrease of the optical power incident on the detector in IFOG [3], and further results in an increase of random walk coefficient (RWC). The RIA is proportional to fiber length, so the IFOG performance could degrade with increasing fiber length. In order to achieve the best performance with the least fiber length to meet the strict requirement on volume and weight of space-borne IFOG, the choice of optimum coil length becomes a very important issue during the design of IFOG. To the best of our knowledge, there is no relevant literatures have been reported.

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2 Theory

The output photoelectric current of the detection in close-loop IFOG with square wave modulation can be expressed as

$$i = \frac{R_D P_d \left[1+\cos\left(\phi_m + \phi_R\right)\right]}{2} \tag{1}$$

where the output DC signal can be written as

$$< i >= \frac{R_D P_d (1+\cos\phi_m \cos\phi_R)}{2} \approx \frac{R_D P_d (1+\cos\phi_m)}{2} \tag{2}$$

The demodulated signal current induced by rotation is

$$i_R = \frac{R_D P_d \sin\phi_m \sin\phi_R}{2} \approx \frac{R_D P_d \sin\phi_m \cdot \phi_R}{2} \tag{3}$$

where P_d is the power returning to the detector without bias modulation, R_D is detector's responsivity, ϕ_R is Sagnac phase shift induced by rotation of FOG, and ϕ_R is minus in close-loop IFOG.

The noise power at the detection, which mainly consists of thermal noise, shot noise, and source intensity noise, may be expressed as [4]

$$i_N^2 = i_T^2 + i_S^2 + i_I^2 = (\frac{4kT}{R_L} + 2e < i > + \frac{< i >^2}{\Delta\nu})B \tag{4}$$

where k is Boltzmann constant, T is absolute temperature, e is electron charge, $\Delta\nu$ is the source spectral bandwidth in the frequency domain, R_L is detection load resistance, and B is detection bandwidth.

Considering (2), (3) and (4), the SNR of the output signal in IFOG can be represented as

$$\begin{aligned} SNR = \frac{i_S^2}{i_N^2} &= \frac{(R_D P_d \sin\phi_m \cdot \phi_R/2)^2}{(\frac{4kT}{R_L} + 2e < i > + \frac{< i >^2}{\Delta\nu})B} \\ &= \frac{{\phi_R}^2/B}{\frac{16kT}{R_L {R_D}^2} \cdot \frac{1}{P_d^2 \sin^2\phi_m} + \frac{2e_0}{R_D P_d \sin^2\frac{\phi_m}{2}} + \frac{\mathrm{ctg}^2\frac{\phi_m}{2} \cdot \bar{\lambda}^2}{c \cdot \Delta\lambda}} \end{aligned} \tag{5}$$

Then the RWC of IFOG can be calculated by

$$RWC = \frac{\lambda c}{2\pi LD}\left(\frac{16kT}{R_L {R_D}^2}\cdot\frac{1}{P_d^2\sin^2\phi_m}+\frac{2e_0}{R_D P_d \sin^2\frac{\phi_m}{2}}+\frac{\mathrm{ctg}^2\frac{\phi_m}{2}\cdot\overline{\lambda}^2}{c\cdot\Delta\lambda}\right)^{\frac{1}{2}} \tag{6}$$

Set the modulation depth ϕ_m as $\frac{\pi}{2}$, the expression of RWC can be simplified as

$$RWC = \frac{\lambda c}{2\pi LD}\left(\frac{16kT}{R_L {R_D}^2}\cdot\frac{1}{P_d^2}+\frac{4e_0}{R_D P_d}+\frac{\overline{\lambda}^2}{c\cdot\Delta\lambda}\right)^{\frac{1}{2}} \tag{7}$$

Considering that P_d decreases with increasing RIA in fiber in the space radiation environment, the maximum optical power received by detector P_d can be expressed as

$$P_d = 2P_o\cdot 10^{-(A_0+AL)/10} \tag{8}$$

This P_0 is the output optical power of light source，A_0 is the initial total loss in the light path system，A is the RIA of fiber，and L is the fiber length of coil.

Submitting (8) into (7)

$$RWC = \frac{\lambda c}{2\pi LD}\left(\frac{4kT}{R_L {R_D}^2}\cdot\frac{1}{\left(P_o\cdot 10^{-(A_0+AL)/10}\right)^2}+\frac{2e_0}{R_D P_o\cdot 10^{-(A_0+AL)/10}}+\frac{\overline{\lambda}^2}{c\cdot\Delta\lambda}\right)^{\frac{1}{2}} \tag{9}$$

Equation (9) gives the relationship of RWC and the fiber length of coil, RIA of fiber, and other design parameters of IFOG.

3 Simulation

In order to investigate the evolution of RWC with the fiber length of coil, numerical simulation on the RWC of IFOG was performed according to (9). Table 1 gives the physical quantity and IFOG parameters for simulation.

Table 1. IFOG Parameters and Physical Quantity for Simulation

Parameters	Physical meaning	Numerical value	Unit
R_D	Responsibility of detector	0.92	A/W
R_L	Detection load resistance	100	kΩ
$\Delta\lambda$	Spectral width	30	nm
λ	Mean wavelength of source	1310	nm
L	Fiber length of coil	0.2-5	km
D	Diameter of coil	0.1	m
P_0	Output power of source	1	mW
A_0	Initial optical circuit losses	18	dB
A	Radiation-induced loss	1,3,5,10	dB/km
e	Elementary charge	1.60207×10^{-19}	C
k	Boltzmann constant	1.38×10^{-23}	J/K
c	Light velocity	3×10^{8}	m/s
T	Temperature	298	K

Fig. 1 shows the evolution of RWC with fiber length of coil for the fiber's RIA is 1dB/km, 3dB/km, 5dB/km, and 10dB/km respectively. It indicates that the RIA has little impact on RWC when the coil length is short. With the increase of fiber length, the influence of RIA in fiber on the RWC becomes significant. Increasing the length of fiber with high RIA would not only increase the volume and weight of the coil, but also could have deleterious effect on the performance of IFOG. Consequently, determination of fiber length of sensing oil in IFOG is a fundamental work in the design the IFOG.

There is an optimum length of fiber coil to achieve the minimum RWC for space-borne IFOG as illustrated in Fig. 1. The RWC decreases with increasing the fiber length of coil at short lengths until reaching an optimum value. It is because the Sagnac phase shift is enhanced by increasing fiber length. Beyond the optimum length, the RWC degrades rapidly with the increase of fiber length which is caused by the increase of total RIA in fiber coil.

Table 2 lists the optimum fiber length and the corresponding optimum RWC in IFOG for different RIA in fiber. It indicates that optimum fiber length decreases with increasing RIA in fiber, and the optimum RWC of IFOG decreases with increasing RIA. It demonstrated that RIA of fiber used for sensing coil is essential for the best performance which can be achieved in IFOG, as it determines the limited sensitivity of space-borne IFOG. In order to achieve high performance for IFOG, radiation-hardened fiber is necessary.

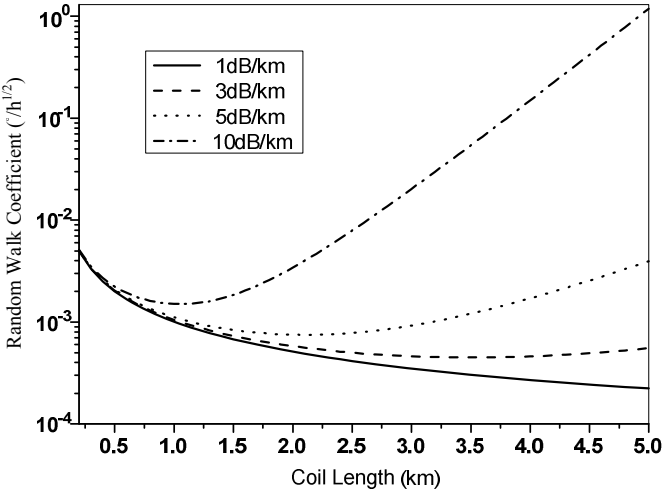

Fig. 1. Dependence of RWC on coil length for four different fiber's RIA

Table 2. The Optimum Fiber Length And Corresponding RWC in IFOG at Different RIA in Fiber

	Optimum fiber length (km)	Optimum RWC (°/h$^{1/2}$)
1dB/km	10.5	0.00015
3dB/km	3.5	0.00045
5dB/km	2.1	0.00075
10dB/km	1.1	0.00150

4 Conclusion

A method to determine the fiber length of sensing coil in space-borne IFOG was proposed in this paper. A mathematical model for RWC versus fiber length of coil with different RIA in fiber was built through the theoretical analysis of the SNR of IFOG output. Simulation on the RWC behavior versus fiber length at different fiber's RIA indicates that there is an optimum fiber length to obtain an optimum performance for a space-borne IFOG limited by the RIA of fiber coil, and the high precision IFOG can only be achieved when the fiber's RIA is low. The impact of RIA is relatively weak in the medium-precision IFOG with short fiber length. However, the determination of fiber length is also very import because the performance of IFOG will significantly degrade once the fiber length exceeds the optimum length.

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Camera Linear Calibration Algorithm Based on Features of Calibration Plate*

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Abstract. In this paper, it presented a completely linear approach for camera calibration. The process is as follows: first, to calibrate the principal point and aspect radio of camera solely, and use CCD shooting the high-precision calibration plate. Second, to apply the SIFT algorithm for extracting the features' centre sub-pixel coordinates of calibration plate. Finally, to solve the other internal and external camera parameters which based on Radial-Array-Constraints and first-order radial distortion model, mainly including the focal length, the first order radial distortion coefficient, the spin matrix and translation vector tz. In the Experiment, in order to eliminate the unstable effects for calibration results which coming from tz, the original linear calibration algorithm has been improved, using a separate calibration translation vector tz ,then experimental data show that the algorithm has high accuracy ,effective and practical calibration method.

Keywords: camera calibration, distortion model, the Scale Invariant Feature Transform, linear calibration.

1 Introduction

One of the basic tasks of computer vision is to calculate the geometric information in three-dimensional space according to the image information obtained from the camera, rebuild and identify the object based on this, while the relationship between the 3-d geometric site of one point in space and its corresponding point in the image is determined by geometric model of the camera imaging, and the model parameters are the camera parameters.

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Camera calibration is the process of determining internal and external parameters of the camera. The internal parameters of the camera are determined by the geometric and optical characteristics inside it, mainly including the focal length f principal point coordinates (u_0,v_0), as well as various distortion coefficients in lens distortion etc.

Camera calibration methods can be divided into two categories: traditional camera calibration method and the self-calibration method.

Although self-calibration method does not require 3-d geometric information of space scenes, it can determine the camera's internal parameters only by using information of images obtained by the camera, it needs to control the camera to perform rigorous motion. Therefore the requirements of experiments are relatively high and the stability is poor.

There is direct linear method[1], nonlinear optimization method[2], Tsai two-step method[3] and Zhang's plane method etc.In typically traditional calibration algorithms. Among them, direct linear method which does not take into account the lens distortion, it's accuracy is low; nonlinear optimization method is relatively complicated, with low speed, and it depends on initial choice very much. If not properly chosen, it is hard to find the correct result.

Tsai's two-step method and Zhang's both firstly use linear method to work out parameters, while they introduce the nonlinear optimization in consideration of lens distortion. In this paper, a linear calibration method considering the lens distortion is presented, it avoids nonlinear optimization. It calibrates five internal parameters of the main point coordinates, aspect ratio, the effective focal length, the first order radial distortion coefficient and six external parameters of spin matrix and translation vector. Experiments proved that the proposed method in this paper is more accurate.

2 Camera Model

The imaging position of any point P in the space on the image can be approximated shown by the pinhole model, that is, the projection site of the point P on the image is the intersection point P_u of the ligature O_cP of optical center O_c & point P with the image plane. This is the ideal perspective projection model.

In practice, there exists optical distortion error between the actual imaging of camera and the ideal imaging because of processing errors and assembly errors in the optical systems of the camera.

Major distortion are radial distortion, eccentric distortion and thin prism distortion. Under normal circumstances radial distortion is able to meet the description of distortion of nonlinear model, so correction for radial distortion just needed in computer vision. Tsai[3] pointed out that when calibrating the camera if too much nonlinear distortion is considered, excessive nonlinear parameters would be introduced. Not only can the calibration accuracy not improved, instead the instability of solution would be caused. Therefore, we adopt a pinhole-order radial distortion model.

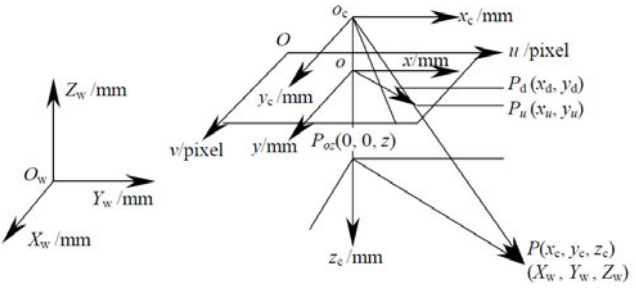

Fig. 1. Pinhole camera model with one-order radial distortion

As shown in figure 1, the model has four coordinates: the image coordinate system O_{uv} of computer; plane coordinate system oxy of image; coordinate system $o_c x_c y_c z_c$ of camera; coordinate system $O_w X_w Y_w Z_w$ of world.

The transformations from world coordinates system to the computer image coordinate system can be divided into the following four steps[4]:

1) The transformation from the world coordinate system to camera coordinate system can be described by rotation matrix R and translation vector t:

$$\begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} R & t \\ o^T & 1 \end{bmatrix} \begin{bmatrix} X_w \\ Y_w \\ Z_w \\ 1 \end{bmatrix} \qquad R = \begin{bmatrix} r_1 & r_2 & r_3 \\ r_4 & r_5 & r_6 \\ r_7 & r_8 & r_9 \end{bmatrix} \quad t = \begin{bmatrix} t_x \\ t_y \\ t_z \end{bmatrix} \quad o = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \tag{1}$$

2) The transformation from camera coordinate system to the ideal image coordinate system:

$$x_u = f \cdot x_c / z_c \qquad y_u = f \cdot y_c / z_c \tag{2}$$

3) The transformation from coordinate system of the ideal image to coordinate system of actual image, the first order radial distortion is considered and distortion model is established:

$$x_d = (1 + k_1 r_d^2) x_u \qquad y_d = (1 + k_1 r_d^2) y_u \tag{3}$$

4) In the formula $r_d^2 = x_d^2 + y_d^2$, k1 is coefficient of the first order radial distortion.

The transformation from coordinate system of actual image to coordinate system of computer image:

$$u = x_d / dx + c_x \qquad v = y_d / dy + c_y \qquad s_x = dy / dx \tag{4}$$

In the formula (c_x ,c_y) are the main point coordinates, (d_x, d_y) are separately the distance between pixels on the unit from x direction and y direction on the image plane. s_x is aspect ratio of the image.

3 The Image Coordinate of Solving and Determining Feature Points of Calibration Board Based on SIFT Calibration

In this paper, HALCON of MVTec company provided standardized template(7×7) is adopted whose size is $0.3\text{m} \times 0.3\text{m}$, with the distance from the center to frame is 0.0375 m and an accuracy of 0.001mm.

SIFT (the Scale Invariant Feature Transform) is one kind of algorithm for extraction features put forward by David G . Lowe, which is based on scale space, image scaling, rotation or even maintaining the affine invariant. First, solve the Gaussian scale space of calibration board image, then carry out detection on extreme value point of multi-scale space by changing the spatial scale of different factors. Every sub- pixel coordinate of each core within calibration board frame can be obtained stably. Figure 2 from experiment as follows:

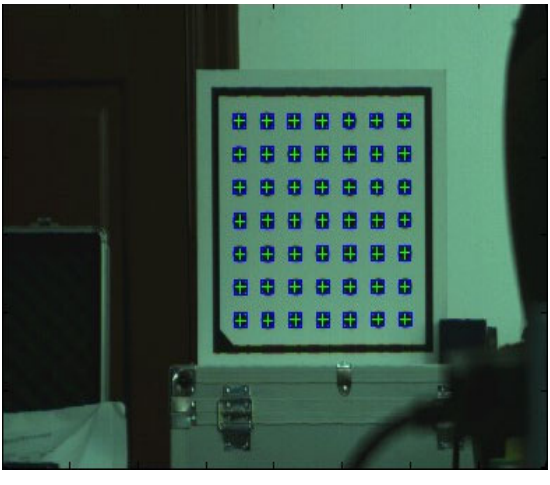

Fig. 2. (a) The original calibration plate (b) Extract features' centre coordinates

As shown in Figure 2 (b), the bright cross line represents the center coordinates of feature points which have been acquired. In filming, it is best to ensure that calibration board and the platform be vertical and right direct to the camera lens, making the feature points on calibration board equal to z in value in the camera coordinate system so as to make sure the smooth progress of demarcation.

4 Linear Solving of Internal and External Camera Parameters

In this paper, direct optical method[5,6] is adopted. The calibration principle is shown in Figure 3:

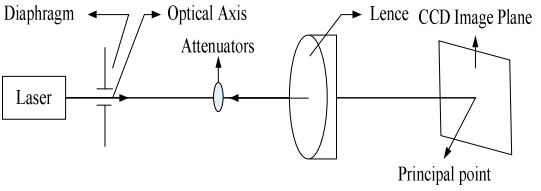

Fig. 3. Direct optic method

Laser beam shoots at the lens surface, most of the light passes through the lens, part of it reflects to every surface from the lens. When the laser beam and the lens are not on the same axis, some diffusing spots in different places formed by the reflected beam can be observed on the surface of emergent aperture slot. At this moment, adjust the relative position of the laser beam lens till all the diffusing spots overlap with emergent aperture slot holes, then the coincide of laser beam with lens axis is acceptable. Afterwards, put a certain rate of decay film before the optical axis of lens, turn on CCD camera, the image point of laser beam on CCD image plane is the lens optical imaging centre. Then the coordinate(u_0,v_0) of main point is the cancroids coordinate solved by spot images.

B. Aspect Ratio of Calibration

As the focal length of camera zooms image in the x and y directions at the same time, so shoot a circle vertically, and then calculate the diameter ratio of horizontal to vertical direction, it is aspect ratio s_x .

C. Solve The Rotation Matrix R and Translation Components t_x, t_y

In this paper, the right angle outside the border point of calibration board's oblique triangle is chosen as the origin of world coordinates. For the calibration board shot is flat, all of its feature points Z_w=0. According to the parallel radial constraint[3,10]:

$$\frac{x_d}{y_d}=\frac{x_c}{y_c}=\frac{r_1X_w+r_2Y_w+t_x}{r_4X_w+r_5Y_w+t_y} \qquad x_d=\frac{dy(u-c_x)}{s_x} \qquad y_d=dy(v-c_y) \tag{5}$$

The linear equations of matrix form is obtained as following:

$$\begin{bmatrix} y_dX_w & y_dY_w & y_d & -x_dX_w & -x_dY_w \end{bmatrix}\times\begin{bmatrix} \frac{r_1}{t_y} & \frac{r_2}{t_y} & \frac{r_x}{t_y} & \frac{r_4}{t_y} & \frac{r_5}{t_y} \end{bmatrix}^T=x_d \tag{6}$$

The 6 elements in column vector of formula (6) is unknown, supposing:

$$p_1=r_1/t_y, \quad p_2=r_2/t_y, \quad p_3=t_x/t_y, \quad p_4=r_4/t_y, \quad p_5=r_5/t_y \tag{7}$$

By transforming into five unknowns, a series of linear equations can be listed based on the feature points' image coordinates and world coordinates of collected images. By using least squares method to solve the over determined equation, p_i(i=1 2..5) is obtained.

For R is orthogonal, when the parameters p_1,p_2,p_4,p is not 0 for and two pairs:

$$t_y = \left[A-(A^2-4B)^{1/2}\right]/2B \qquad A = p_1^2+p_2^2+p_4^2+p_5^2 \qquad B = (p_1p_5-p_2p_4)^2 \tag{8}$$

Otherwise, t_{y2} is the reciprocal of the other two parameters' quadratic sum. Then obtain:

$t_x = p_3 \times t_y$, $r_1 = p_1 \times t_y$, $r_2 = p_2 \times t_y$, $r_4 = p_4 \times t_y$, $r_5 = p_5 \times t_y$, $r_3 = \sqrt{1-r_1^2-r_2^2}$, $r_6 = \sqrt{1-r_4^2-r_5^2}$ (According to orthogonality, if $r_1r2_4+r_2r_5$ is positive, the negative sign should be added in front of r_6.

Still according to orthogonal R, solve the following equations, obtain r_7,r_8,r_9 :

$$\begin{cases} r_1r_7 + r_2r_8 + r_3r_9 = 0 \\ r_4r_7 + r_5r_8 + r_6r_9 = 0 \\ r_7^2 + r_8^2 + r_9^2 = 1 \end{cases} \tag{9}$$

D. Solve The Focal Length f, First-order Radial Distortion Coefficient k1 and The Translation Component t_z.

By the formula (1) (2) (3):

$$x_u = f\frac{x_c}{z_c} = \frac{x_d}{1+k_r r_d^2} = f\frac{r_1X_w + r_2Y_w + t_z}{r_7X_w + r_8Y_w + t_z},$$

$$y_u = f\frac{y_c}{z_c} = \frac{y_d}{1+k_r r_d^2} = f\frac{r_4X_w + r_5Y_w + t_z}{r_7X_w + r_8Y_w + t_z} \tag{10}$$

Organize the linear equation including f,k_1 and t_z:

$$\begin{bmatrix} E & E_d^2 & -x_d \end{bmatrix} \times \begin{bmatrix} f & k & t_z \end{bmatrix}^T = x_dG \quad ,$$
$$\begin{bmatrix} F & Fr_d^2 & -y_d \end{bmatrix} \times \begin{bmatrix} f & k & t_z \end{bmatrix}^T = y_dG \tag{11}$$

$$E = r_1X_w + r_2Y_w + t_z, F = r_4X_w + r_5Y_w + t_z, G = r_7X_w + r_8Y_w, k = fk_1$$

Finally, combine the two equations in formula (11) into one linear equation, solve the values of three parameters f,k_1 and t_z.

5 Experimental Results and Analysis

In the experiment, the OK-AC1300 model camera is applied whose resolution ratio is 1300×1024pixel, pixel size is 4.65μm, 35mm fixed lens, who cam output 8bitRGB image. The size of HALCON calibration board image actually collected is 800×600pixel, with 49 feature points in all. As shown in Figure (4).

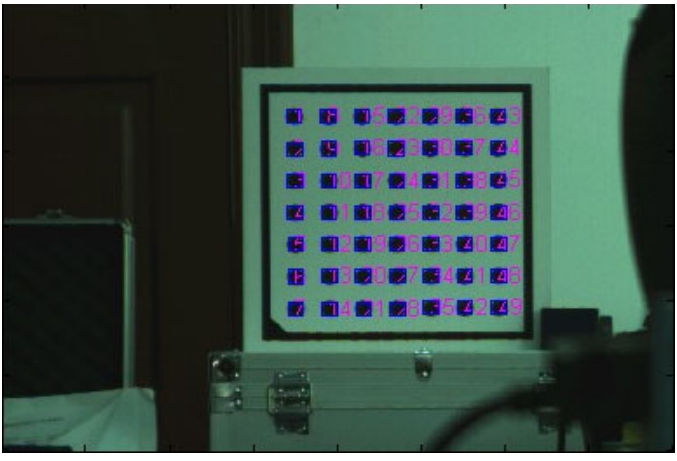

Fig. 4. Counts of features

By calculating the image coordinates and world coordinates, calibrating based on three steps, instability of focal length f appears with the changes of the number of testing points, as shown in Figure 5:

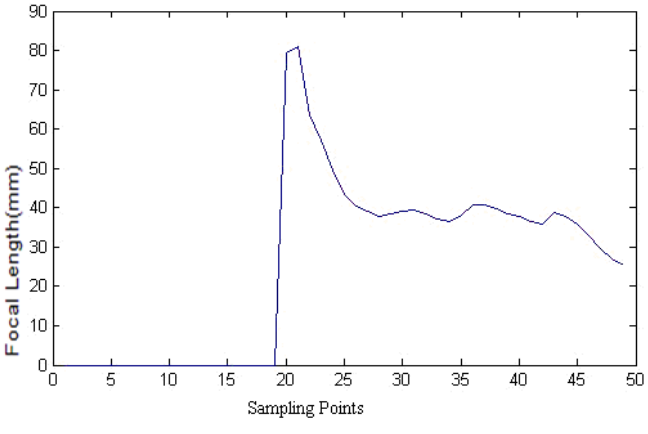

Fig. 5. Focal length f curve

After several experiments, the changes in focal length are much affected by translation component tz. The difference of number of testing points makes tz change with it. Therefore, the phase laser distance gauge is used to measure the vertical distance from CCD image plane to calibration board, that is t_z. And improve the original algorithm, (9) is amended as follows:

$$\begin{bmatrix} E & E_d^2 \end{bmatrix} \times \begin{bmatrix} f & k \end{bmatrix}^T = x_d (G + t_z), \quad \begin{bmatrix} F & Fr_d^2 \end{bmatrix} \times \begin{bmatrix} f & k \end{bmatrix}^T = y_d (G + t_z) \quad (11)$$

The focal length obtained after recalculating changes with testing points and gets better convergence near f=35mm. As shown in Figure 6:

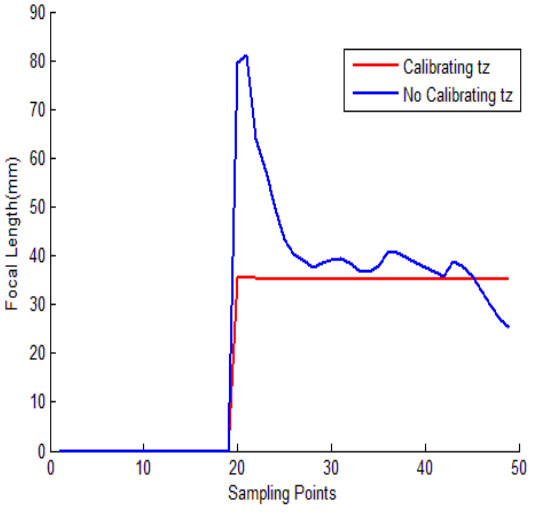

Fig. 6. Focal length f curve with calibrating tz(rad line) and no calibrating tz (blue line)

In this paper, the description on the average model value of the difference between true coordinate and corresponding image coordinate after re-projection of testing points is adopted, the unit is pixel, as shown in the following formula:

$$E_{AVG} = \frac{1}{n}\sum_{i=1}^{n}\left[\left(u_i' - u_i\right)^2 + \left(v_i' - v_i\right)^2\right]^{1/2} \tag{12}$$

In the formula, (u_i,v_i) is true image coordinate of testing points, (u_i,v_i') is after re-projection, n is testing point.

By using the algorithm in this paper, calibrated results is obtained as following:

s_x=0.9780,(u_0,v_0)=(311.53,624.81),k1=9.0636,f=35.0729,

$$R = \begin{bmatrix} -0.6861 & 0.0039 & 0.7275 \\ -0.0020 & -0.7275 & 0.6861 \\ 0.4810 & 0.8436 & 0.2387 \end{bmatrix}, \mathrm{t} = \begin{bmatrix} 0.1272 \\ 0.0008 \\ -4.8920 \end{bmatrix}$$

35 feature points were chosen as calibration points, and the other 14 as testing points. After the error analysis EAVG=0.7282pixel was got. It shows that the calibration precision is high. It is also verified through the comparison of the focal length's calibration value to the designing value.

6 Conclusion

In this paper, a simple and effective method of linear calibration of the camera is presented. By choosing high-precision HALCON calibration board as calibration model board, conduct a one-time shooting against CCD camera calibration board needed calibration. The sub-pixel accuracy is reached by applying the SIFT algorithm for the effective extraction of coordinate of feature point from calibration board image. At last, all linear calibrations of parameters of the camera are completed step by step, and the complication of nonlinear optimization is avoided. In the process of calibration, owing to the change of calibration results, the instability of some parameters such as focal length f is caused. So the original algorithm is improved in the paper. tz is calibrated independently, that leads to a better results in the convergence of the focal length f. Experiments show that the precision is higher for most of the camera calibration, in the field of machine vision application, the method has wide applicative value.

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The Development Research on Higher Vocational Education Curriculum Based on the Working Process

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Abstract. The higher vocational *course* reform, based on the working process, is one of the core contents of the 21st century's vocational education reform, which can be mainly realized through schools-business cooperation and achieved based on the integration of work and study as well as the creation of the teaching mode scenarios. The guidance of the curriculum implementation lies in action. Meanwhile, great attention should be paid to consummate the training conditions, the establishment of working scenes, the reform of inspection and the development of teaching resources. It has manifested the characteristic of higher vocational education, which is advantageous in raising the students' competence in post and their professional quality.

Keywords: working process, educational model, curriculum system, training base.

Based on working process oriented curriculum development is facing the twenty-first Century German" dual system" occupation education reform [1] one of the core content. Based on the working process of the curriculum is to break the traditional discipline curriculum system, replacing them with the enterprise practice closely linked, the study of theory and skills training of highly uniform, according to the working process sequence" comprehensive" and" case of" teaching project.

1 Introduction

1.1 The Working Process of the Connotation

Process [2] is the concept with a rich connotation, not only refers to the work of a series of processes and tasks, but also including the conditions, environment and situation, need to work ability and other related conditions. In the work process oriented curriculum will be based on practical activities to spread, the work process oriented practical curriculum based on behaviorism learning theory of construction foundation, action orientation is" doing" this simple thought reflected, the main research task is to analyze and explore how the activity to obtain knowledge and skills.

Based on working process oriented curriculum, to break the imparting of knowledge as the main feature of the traditional teaching pattern, change is with the work process oriented organization course content, and to enable students to complete the specific items in the process of society to complete the corresponding tasks, constructing

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relevant theoretical knowledge, the development of occupation ability. Course contents highlight the students' occupation ability training, integration of the related occupation qualification certificate to the knowledge, skills and attitudes required. In the teaching process, through the cooperation between school and enterprise, the inner-practice base construction and so on many kinds of ways to fully develop learning resources, to provide students with a wealth of opportunities for practice.

1.2 Based on the Working Process of the Curriculum Development of Higher Vocational Education the Significance of the Study

Higher vocational education in our country is still in the exploration and reform of the important stage, how to make the course construction and occupation need effective convergence is higher vocational education reform in China focus. The higher occupation education in the development of higher education as a type, culture is oriented production, construction, management and service the needs of first-line of high-quality skilled talents. Therefore, in order to academic talents for the purpose of discipline curriculum construction mode is not adapted to the higher occupation education skill training of specialized personnel, should be based on certain curriculum development law, developed in line with the technology, occupation and occupation standard, promoting students' employment, highlight the characteristics of school based curriculum, achieve higher occupation education personnel training objectives [3].

The traditional subject system of each course course order about the integrity of the content, content to sort is in accordance with the cognitive law from the simple to the complex arrangements, and practice of large, spaced far apart, often appear the relevant practice has learned theoretical knowledge forgetting. Long-term since, occupation education curriculum in microcosmic content design and layout is far from out of the discipline system of barriers, in this traditional idea to manacle to prepare teaching materials always can not adapt to the need of curriculum content occupation, structured, namely the course contents in a logical order, had become restrict occupation education reform success or failure the key.

Based on the working process of the curriculum is a highlight in the practice context through students' self construction of knowledge and the process of logic as the center of the action system. According to the working process of sequential development course, highlights the occupation education curriculum development breach, which emphasizes the high-tech condition and working process about tacit knowledge -- experience of the important position, while emphasizing the subject system of knowledge should not be instilled by the students in the learning process of" action" in the construction of self and. Based on the working process of the curriculum has broken the traditional discipline curriculum system, replacing them with the enterprise practice closely linked, the study of theory and skills training of highly uniform, according to the working process sequence" comprehensive" and" case of" teaching project.

Based on the working process of the curriculum can not only cultivate students' working ability and the team cooperation spirit, can arouse the students' initiative and creativity, make the students self study ability, independent problem-solving skills have improved, conducive to the cultivation of students' ability. Therefore, the curriculum based on working process is more advantageous to the student comprehensive occupation ability training.

2 Study on the Curriculum Development Plan and Plan

2.1 Reform Content and Target, the Key Problems to Solve

(1) Contents of the reform

Based on the working process of the curriculum reform includes the reform of teaching content, teaching mode reform and innovation of teachers.

First of all, teaching contents, course structure system of out of bound, the pursuit of working process systematization, stressed with work related knowledge status of subject system, weakening the impartation of knowledge; in the selection of curriculum content in terms of simplified declarative knowledge, strengthening the process knowledge; the content of the course the order, according to the students the cognitive law and professional corresponding occupation work order, oriented by the working process, the curriculum content serial arrangement, in accordance with the typical sequence of occupation of each link of teaching related to the course content.

Secondly, the teaching way reform, should be the traditional teaching method into case teaching method, through comprehensive project teaching method and situational teaching method; teaching content teaching mode should be subject to the working process of structure conversion, to the occupation ability training as the center emphasizes curriculum theory knowledge and the work process of the integration of cognition in practice.

In the construction of teaching innovation to improve professional teachers, especially young teachers ideological understanding, on" the curriculum based on working process" this one thought to realise and hands-on experience, use of all facilities to counterpart enterprises practice of professional knowledge, to live up to one's name of" double type" teachers. Based on the working process of the curriculum reform of teachers job raised new requirement, the occupation, teachers must have experience, understand the business background, familiar with the working process, master the technical requirements and quality standards; second, teachers should have a curriculum development and design capabilities, can be the typical tasks into suitable for teaching, has the the educational value of the learning content, and through the whole teaching design theoretical knowledge and practical knowledge are organically combined to work process. The teacher own quality and ability, the teacher teaching way is the change of the curriculum reform is important assure.

(2) The reform target

Based on the working process of the curriculum reform so that the occupation education out of discipline system manacle, adapt to the occupation work need, ensure of declarative knowledge and procedural knowledge, theoretical knowledge and practical knowledge in an organized way of knowledge integration, sort and knowledge acquisition methods of integration, the reform of teacher knowledge structure, training double-skilled teachers, the reform of students' knowledge structure and professional quality, make it adapt to the need of job occupation.

(3) The critical problems to be solved

Based on the working process in the reform process of the key problems to solve are: first is the curriculum setting, solve the selection of curriculum content orientation and course content of the sequence structure; second is the simulation of working process

oriented teaching environment, based on the working process of the curriculum reform and implementation relies on traditional teaching environment innovation, improve the teaching process of the hardware and software environment, make it more adapted to the needs of occupation education. Finally, based on the working process of the teaching design is the key of the curriculum reform, select the appropriate teaching strategies, teaching process each link to students, teaching materials, teaching aids, equipment such as careful planning, formulate corresponding teaching plans and teaching programs.

2.2 Implementation Plan, Method, Program and Feasibility Analysis

⑴ The implementation scheme

① The counterparts to carry out investigation and research of enterprise. Based on the working process of the reform of the first need instructional designers and participants understand counterpart enterprises working process, which requires in-depth business research, research content includes: business job settings, job responsibilities, tasks, occupation ability, professional work processes and conditions, culminating in the formation of talent demand and occupation ability demand schedule report.

② The technical personnel and backbone teachers of University and college studies curriculum reform. Invite the business of professional and technical personnel and professional backbone teachers face to face, studies the curriculum reform, the main tasks: from simple to complex on task argumentation; determine the working process of corresponding knowledge form learning field; demonstration of professional personnel training specification; argumentation course target. The final argument results in the formation of expert opinion table, establishing a professional position, set professional standards, curriculum objectives.

③ The proper design of curriculum contents. The links including design of curriculum types and content of knowledge in two areas. Curriculum types are divided into occupation activity curriculum and integrated curriculum. Occupation activity curriculum should choose a comprehensive learning task, the task of constructing a typical occupation activity process, according to the process aspects of the required skills, knowledge and behaviour of a decomposition of the formation of learning unit, and then the implementation of teaching. Integrated curriculum around the occupation skill or occupation ability of the original parallel arranged much door teaching subjects integrated into less teaching subjects, can keep the basic form of discipline curriculum. Knowledge content knowledge refers to the knowledge structure, the selection of curriculum development, this is the two basic elements: one is the curriculum content selection criteria, two is the curriculum content sort criteria. The end result is to choose a reasonable curriculum system.

Based on the working process of the curriculum can reflect the working process of the elements, and to reflect the mutual connection between these elements; at the same time, allow students to personally experience the structural integrity of the work processes, to enable students to gain" work process knowledge", is more advantageous to the student comprehensive occupation ability training.

④ The overall design teaching. Based on working process oriented curriculum, the teaching design is the key to realizing the goal of curriculum. One is to choose proper

teaching strategies, two is the reform of teaching methods and means and development, teaching content teaching mode should be subject to the working process of structure conversion, namely the occupation action knowledge by integrating the theory and practice of capacity development conversion; teaching sites by theory classroom to multi function integrated professional classroom conversion, i.e. both theoretical teaching, group discussion, experiment and practical teaching location conversion. Three is a reasonable distribution of teachers. Eventually make feasible teaching plan.

⑤ The evaluation of curriculum reform. Based on the working process of the curriculum development mode of curriculum evaluation, is directed to a process, the curriculum development mode under the curriculum standard, curriculum management, curriculum implementation evaluation and make course management activity, is the professional personnel training objectives, available resources, and the development needs of students as a reference, of course, the scientific sex the feasibility and validity of the objective measure, discussion, evaluation, value judgment. The establishment of evaluation mechanism aims at diagnosis, course and course correction value confirmation courses. Through an objective assessment, and the development process of necessary survey and argumentation, can achieve the anticipated goal.

⑵ The implementation method

① Strength and counterpart business links, except in the curriculum development process to make enterprises participation outside, should be timely collection of enterprises of new knowledge, new requirements, should also be quickly reflected the enterprise to use the feedback results as well as on curriculum program for correction and adjustment. Create and use convenient conditions for teachers and students to research and practice.

② Improve the teaching environment of hardware conditions, can be taken from a class to a professional direction to the entire professional way to gradually improve the teaching environment, take the horizontal comparison and vertical comparison way of evaluating teaching environment is to promote the curriculum reform.

③ The execution of the loop investigation, argumentation, implementation and evaluation processes, stepwise refinement based on teaching reform.

⑶ The implementation plan

The first is the professional backbone teachers to counterpart enterprises research, experience of work process, determine the knowledge learning area, and technicians to demonstrate professional talents training standard and curriculum goals. The choice of scientific curriculum system, developing a detailed teaching plan, teaching based on the work process of design and implementation, and the problems in time correction. Secondly, based on the work process curriculum reform process and effect of examination and evaluation, improve the relevant details, formed a comprehensive work process based curriculum teaching in new situation.

⑷ The feasibility analysis of

① The traditional teaching patterns: long-term since, occupation education curriculum reform stalled because the course design and arrangement of micro content not jumped out of the discipline system of barriers, the preparation of teaching materials always can not adapt to the occupation work need. Curriculum content,

curriculum contents in a logical order, already became restrict occupation education curriculum reform key.

② The characteristics of occupation education requirements: an occupation can become an occupation, because of its special work process, namely in the working mode, content, method, organization as well as the tools of history development has its one's own knack in. Thus, occupation education should pursue the working process of the system rather than subject structure system, curriculum development will need to establish the work process based curriculum view [4].

③ The work project advantages: curriculum development based on working process, the first is to describe and analyze the work process, only the system, effective work process analysis, in order to grasp the working structure, accurate positioning of the working process for the needed knowledge and skills. Working process analysis and description is according to the profession or occupation demand, the task is decomposed into a number of working process, at the same time on each work process to complete the content description. Higher vocational education should enable students to gain the structural integrity of the work involved in the process to the procedural knowledge, skills and related occupation occupation experience, in order to promote the occupation ability formation for the purpose of.

3 Based on the Working Process of the Curriculum Development of Higher Vocational Education the Implementation of Research Results

3.1 Developed Based on "Work Process" Course System

We learn from" Beida Jade Bird"," John Ziang education group" course system, strengthen the connotation construction, the occupation skill competition and occupation skill appraisal into the curriculum system, established the occupation activity guidance, vocational students based on" practical working process" of the curriculum system of secondary vocational curriculum, is no longer the" extended edition" and" undergraduate course compression version", promote the students' comprehensive occupation ability training.

3.2 Exploring a Set Based on the "Working Process" of the "Teaching" Integration Teaching Mode

"Teaching" integration teaching mode must be in the course of training room, business scene teaching and" teaching" integration of classroom based on" teaching", from the three aspects of comprehensive and in-depth.

Teachers should gradually shift to classroom teaching, teachers mainly consisting mainly of traditional teaching method, case teaching, scene teaching attempt actively, team learning, teaching, teaching methods and means of project embedded, to inspire students to think independently, independent study, students cultivate the spirit of cooperation and innovation consciousness, improve the students' practical ability and solve the actual problem ability.

Training students to learn to learn, learn the good style of study and subject consciousness of learning, and constantly improve the students autonomous learning environment, make students study way gradually diversified. Through the platform of network teaching, students can understand the basic information of the course, teaching resource and information industry, realize between teachers and students, students online interaction, improve teaching efficiency.

Do the practical principle, advocate of teaching equipment and teaching aids, to provide students with a good training environment. Extension of class practice teaching link, open training room, and actively explore business internship production base, so that students can participate directly in the installation, debugging and maintenance process, forming a career of teaching atmosphere, so as to improve the students' practice ability, innovation and entrepreneurship.

3.3 Establish Teachers Training Mechanism and Based on the "Working Process" with the Standards of Teaching Evaluation

The new mode of teaching requires teachers to have more extensive professional and higher practical ability, must be familiar with a variety of production practice, learn about the latest policy and implementation. Therefore, we have the plan step by step selected groups of young teachers to Beida Jade Bird the learning of new teaching mode, to key institutions of higher learning the frontier knowledge, in-depth factories and enterprises to practice skills training, creating a large number of practical ability, high level of business, the new teaching model of" double type" teachers.

Through the demonstration, experiment, theory to practice, to establish a set of combined engineering as a platform, with the working process as the fundamental, to task for the drive, to the occupation ability analysis as the basis, according to post field design content of teaching and learning situation, conform to the occupation education requirements based on the" working process" teaching evaluation mechanism, scientific evaluation of teachers' teaching level and students' learning achievement, to" professional fame, teacher development, students" direction.

4 Effect Analysis

4.1 To Mobilize Students' Non-intelligence Factors to Actively Participate in Learning Activities

Non intelligence factors in learning plays a very important role, it is an important aspect in the development of students, the development of intellectual plays a regulatory role in promoting and. Based on working process oriented curriculum design, to enable students to consciously, volunteered to participate in learning, stimulate students' interest in learning, enhance their self-confidence.

4.2 To Strengthen the Students' Intellectual Activity, Improve Teaching Quality and Efficiency

Intelligence factors include observation, attention, memory, imagination and other elements, which are directly involved in the cognitive process of mental activity,

influence the understanding and acceptance of. Based on working process oriented curriculum development for the full development of students' intelligence, to improve the teaching quality of open up broad prospects. According to the significant (hypothesis) test theory [4] by analyzing experimental data, experiments show that, based on the work process oriented curriculum design effect is remarkable, it makes the students in the occupation quality of occupation skill, comprehensive aspects has been enhanced greatly.

5 Conclusion

Based on" work process" of the curriculum development and practice, we feel the work process based curriculum content and not from the discipline system theory knowledge guided out of the indirect knowledge, nor a single operation knowledge, it includes work experience, production and production process and other aspects of knowledge, but also includes different labor and how enterprise whole linked to knowledge. Based on the working process of the higher vocational colleges is the direction of teaching reform, aimed at market post design course, emphasizing curriculum application. This kind of teaching model of task driving, situational teaching, project teaching, case teaching methods as one of the combination of methods, so that students in a" learn by doing, learning to do", fully embodies the characteristics of Higher Vocational education. Based on the" working process" teaching Deepening Higher Vocational Education" to serve the community for the purpose, take the employment as the guidance, combine work and study, produce learn to grind combinative road" for the tenet, fully embodies the teaching principle of employment market orientation, can greatly improve students' employment competitive ability.

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Empirical Study on Customers' Satisfaction of Commercial Bank with Motivation-Hygiene Theory

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Abstract. The Traditional satisfaction theory explains that the satisfaction and dissatisfaction make up of one continuum, so the banks should adopt the necessary measures to improve the clients' satisfaction of various aspects, further to boost up the competition power of the enterprises. Based on the survey of the satisfaction regarding the bank service and using the fuzzy-cluster analysis measure, this paper finds that the phenomena of the satisfaction more meet the description of the Motivation-hygiene Theory, and suggests that commercial banks should distinguish the motivation factors and hygiene factor rightly to use enterprise's resources effectively.

Keywords: Satisfaction, Motivation-hygiene Theory, Customer Behavior, Motivation Factor, Hygiene Factor.

1 Introduction

Foreign banks have accumulated customer-oriented marketing over time with the concept of integrated services function that a modern commercial bank's core competence lies in its ability to operate to achieve customer satisfaction, which, for the domestic commercial banks, the way to cope with fierce competition is clearly enhance customer satisfaction, for commercial banks, effectively enhance customer satisfaction has become the traditional dominance of commercial banks gradually fade the only way out. Research on this issue, the country has Zhao Bian (2009) from the relationship marketing perspective is analyzed [1], Zhang Shengliang (2008) to build a banking industry customer satisfaction measurement model, then China's commercial banks and the factors affecting customer satisfaction a more systematic comparative analysis [2], Liu Fengjun (2009) from the angle of bank-enterprise relationships promote customer satisfaction, an important factor for customers to improve the quality and expertise of managers, etc. [3]. In addition Li, JH, Zheng Yi Ni and other commercial banks to build customer satisfaction evaluation system conducted a study. [4] The author also carried out in 2005, the system of state-owned commercial banks customer satisfaction empirical research (Wang Jinfu, 2005), but now sum up, these empirical study of satisfaction surveys and more satisfaction with the traditional theory of description, the use of similar to the "Likert Scale" of the scoring method, the study has the potential assumption that evaluation of satisfaction and dissatisfaction to form a unity. However, this is the reality there are some differences to two-factor theory analysis, satisfaction and dissatisfaction is not one to one entity, in which there are health factors and

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incentives of the points. This means that not all measures to improve customer satisfaction to achieve the purpose of enhancing customer satisfaction. Thus, the traditional satisfaction theory and existing research methods to enhance the satisfaction made under the direction of banks will inevitably lead to waste of resources, even in the fierce competition in the market at a disadvantage. Therefore, to confirm the formation of customer satisfaction in commercial banking in the existence of two-factor effect, it becomes very important. For this purpose, two-factor theory of content in accordance with this article, combined with domestic commercial banks, customer satisfaction surveys, customer satisfaction on commercial banks during the formation of the existence of two-factor effects were tested.

2 Research Methods

2.1 Survey Design

(1) Customer Satisfaction Measurement is a quantitative analysis of the nature of the process, in the survey, the measure be quantified, in digital form to reflect the attitude of the consumer banking industry. Questionnaire using Likert-type multi-option scale method (Multiple-item scales), 5-point scale way to scale the project scoring level 1 is the lowest, 5 is the highest level. The fourth part is fill in the blank with the chosen approach, the personal background of the survey data, including age, gender, education, jobs, nature of work and other aspects of the design issues relevant items. Specific measure for the survey: overall satisfaction, 100 were chosen rate, types of business, convenience, public image, reputation, security, quality of service, charges, quality of personnel, environmental facilities.

(2) the use of this survey in Xi'an way street survey, the proportion of the population of the random number sample selection of 200 aged between 18-65 years old for regular banking business of individual consumers, not for the sex survey special restrictions;

(3) The survey covered banks include: Industrial and Commercial Bank of China, Construction Bank, Agricultural Bank, Merchants Bank, Bank of Communications, Minsheng Bank, Shanghai Pudong Development Bank;

2.2 Reliability and Validity

Scale using Cronbach a coefficient of reliability of methods for reliability testing, the reliability coefficient of 0.9205. It can be that the scale of the survey data and high reliability. Factor analysis of questionnaire results show that the impact factor of the common factors of the cumulative variance contribution rate of 88.32 percent, showing that the idea of the questionnaire have a higher validity.

3 The Problem and Assumptions

3.1 Issues

According to the traditional theory of satisfaction, overall satisfaction with the types of business, convenience, public image, reputation, security, quality of service, charges,

quality of personnel, facilities, environmental and other indicators of satisfaction should be positively correlated, that these sub-indicators satisfaction on overall satisfaction with banking services to promote the role. But the data differ greatly even with the expected results have the opposite situation (as shown in Table 2).

Table 1. Bank of satisfaction (5 standard)

Name of Bank	overall satisfaction	Types of product	convenience	public image	well-known	quality of service	fees	security personnel	Quality	environment and facilities
Industrial and Commercial Bank	3.60	4.50	4.30	3.40	3.90	3.46	3.80	3.49	3.15	3.41
Bank of China	4.05	3.50	4.20	3.90	4.25	3.72	3.30	3.65	3.20	3.58
Construction Bank	3.98	4.10	4.00	3.60	3.92	3.81	4.00	3.62	3.61	3.38
Agricultural Bank	3.60	3.60	3.90	3.70	3.51	3.62	4.00	3.50	3.50	3.49
Merchants Bank	4.08	4.20	3.50	3.90	4.10	4.00	3.55	4.20	4.00	4.29
Bank of Communications	3.52	3.35	3.70	3.10	3.89	3.73	4.00	3.30	3.42	2.56
Commercial banks	3.20	3.20	4.00	3.20	3.62	3.65	3.60	3.61	3.30	3.52
Minsheng Bank	3.00	3.00	3.50	3.00	3.20	3.50	3.50	3.60	3.51	3.70

Table 2. Correlation coefficient between overall index and sub-indicators

	Business Type	Convenient	Public image	Popularity	Quality of service	Security	Charges	The quality of personnel	Environmental Facilities
Overall satisfaction	0.651	0.241	0.886	0.871	0.702	0.463	-0.008	0.316	0.242

Given Distribution of values from the table, combined with the traditional satisfaction theory, we can see that there is a big difference. One important reason is that the traditional theory of satisfaction regard f the customer satisfaction and dissatisfaction as a continuum, but when customer is considering service quality,these two are considered separately, that dissatisfaction degree and satisfaction degree are considered separately, actually which is the management theory of two-factor theory, this shows that you can use two-factor theory on bank customer satisfaction research.

3.2 Hypothesis about Two-Factor Customer Satisfaction on Commercial Banks

According to two-factor theory of content, attributes affecting all the factors of customer satisfaction of the commercial banks, can be divided into Maintaining property and incentive property, when maintaining property is poor, it will cause dissatisfaction, but maintaining property to meet, it can eliminate consumer dissatisfaction, but can not serve to enhance consumer satisfaction results; when incentive property is poor, it will lead to consumer satisfaction decline but no significant decline in dissatisfaction, when the incentive property improves, it will increase consumer satisfaction.

According to two-factor theory, we can propose the following hypotheses:

Hypothesis 1: In the banking services customer satisfaction subject to two-factor theory hypothesis.

Hypothesis 2: Customer satisfaction and incentive indicators show a clear correlation, the correlation between customer satisfaction and maintaining factors is not obvious;

Hypothesis 3: Customer dissatisfaction and maintaining factors show a clear correlation, the correlation between customer dissatisfaction and incentive factors is not obvious.

To test the assumptions, we must first identify the incentives and maintaining factors. The distinction of incentive factors and maintaining factors need to be determined by correlation coefficient of the various sub-overall satisfaction, with the to the correlation coefficient is greater than the 0.5 attributed to motivational factors, the correlation coefficient is less than the 0.5 attributed to maintaining factors.

Based on the above assumptions, the indicators used for research were classified initially, types of business, public image, reputation and service quality as the motivating factors; convenience, fees, quality of personnel, environment and facilities as maintaining factors. Figure 1:

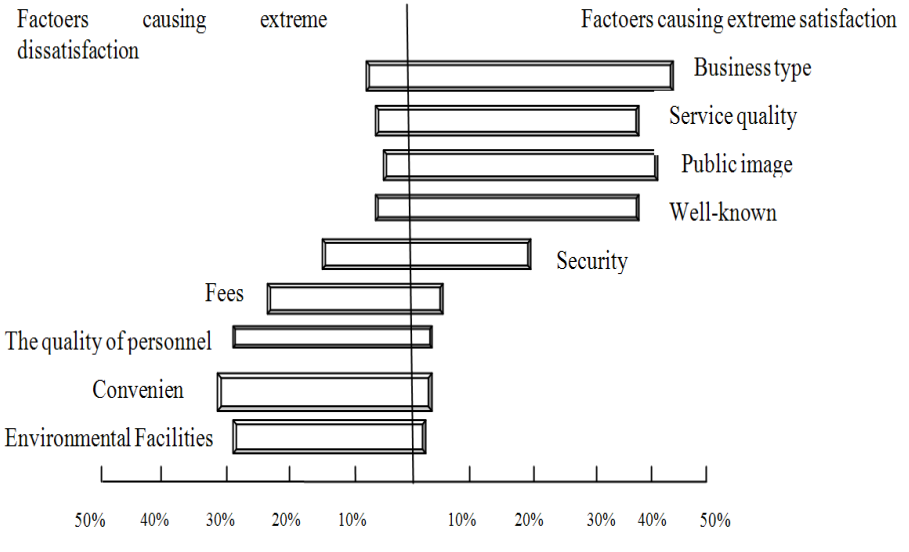

Fig. 1. The comparison of Satisfaction and dissatisfaction factors

Bank customer satisfaction incentive factors and maintaining factors have the following characteristics:

(1) maintaining factors generally have been developed by the banks and the level is very and difficult to achieve a breakthrough, among these factors, some banks do bad, which affect consumers' satisfaction of the Bank; if these factors are improved, the benefits to consumers is below the cost consumers that switch banks, so the banks spend a large cost increase to improve customer satisfaction, which contribute little.

(2) incentive factors generally have been developed by banks and the level is equivalent, they are the product / service attributes which the banks are likely to achieve greatly improved. Lack of these factors does not seriously affect the bank's customer satisfaction, but if the factors are greatly improved, they will brings benefits to consumers than cost to replace the bank, which will greatly enhance the bank product / service customer satisfaction. Incentives should also have both characteristics to produce value-added for consumer and non-imitative (or original), once the innovation of new attributes easily imitated by competitors, the property will become maintaining factors.

4 Hypothesis Testing

Based on the foregoing assumptions, we obtain the following corollary: satisfied customers incentives associated with high satisfaction, and maintaining factors of dissatisfied customer associated with high degree of dissatisfaction.

Table 3. Correlation coefficient between Satisfactions and the sub-indicators

	Business Type	Convenient	Public image	Popularity	Quality of service	Security	Charges	The quality of personnel	Environmental Facilities
Overall satisfaction	0.832	0.323	0.853	0.805	0.798	0.436	0.350	-0.302	0.185

In order to test hypotheses inference, firstly based on the sample overall satisfaction of bank customers, the sample is divided into satisfied customers and dissatisfied customers. Using two different customers we test the relevance of overall satisfaction and sub-indicators to determine incentives and test the relevance of dissatisfaction and various sub-indicators to confirm maintaining factors.

In the previous analysis, customers who have a general evaluation on bank service will be discussed in satisfied group and dissatisfied group. But if satisfaction and dissatisfaction belong to two separate individuals, customers who have a general evaluation on bank service should also be divided into two categories that were attributable to satisfaction and dissatisfaction groups. And the classification of the general group will increase the relevance of between satisfaction, dissatisfaction and incentives, maintaining factors.

Table 4. The correlation coefficient between dissatisfaction and sub-indicators

	Business Type	Convenient	Public image	Popularity	Quality of service	Security	Charges	The quality of personnel	Environmental Facilities
dissatisfaction	0.365	0.891	0.264	0.315	0.403	0.50	0.672	0.763	0.650

According to the survey data, 20 samples individual have a general evaluation of banking services, which determine the domain of discussion is $U = \{x_1, x_2, \cdots, x_{20}\}$. each individual will be discussed by 10 indicators: overall satisfaction, types of business, convenience, public image, reputation, quality of service , security, fees, facilities, personnel quality and environmental indicators.

For the above data, using Euclidean distance formula [7] $r_{ij} = 1 - C\sqrt{\sum_{k=1}^{m}(x_{ik} - x_{jk})^2}$,to Define the similarity degree to satisfaction between any two individual samples, so the sample analysis is divided into the problem of 20-order matrix dynamic clustering analysis, establish fuzzy similar matrix R_{20x20}, according to the fuzzy math theorem, we know that there must be the smallest natural number k ($k \leq 20$), making the transitive closure t (R) = R^k, for every natural number 1 greater than k, constant with, then t (R) is the fuzzy equivalent matrix. Based on the square method to obtain the transitive closure level t (R):

$$R \rightarrow R^2 \rightarrow R^4 \rightarrow \cdots \rightarrow R^{2^i} \rightarrow \cdots$$

When the first time they appear, $R^k = R^k$ (is transitive), R^k is the desired transitive closure t (R). In this paper, fuzzy equivalent matrix is obtained by Matlab6.1 package. Strike the λ-cut matrix R_λ of $\lambda = \{1,0.8,0.6,0.4,0.2\}$. Thus different samples included from various values of λ is found (see Table 5).

Table 5. The sample number of different levels of λ

λ	1	0.8	0.6	0.4	0.2
Number of sample	0	8	10	11	19

Above table it can be found that samples of general bank satisfaction are divided into two groups, their differences are significant. These two types of individuals were classified as satisfied and dissatisfied groups, re-examine the degree of correlation

between the individual overall satisfaction and the sub-index, it is found when the individual of $\lambda \geq 0.6$ is incorporated into the satisfaction group, but when individual of $\lambda \prec 0.6$ is incorporated into the dissatisfied group, we gain correlation coefficient:

Table 6. The sub-adjusted correlation coefficients between satisfaction and sub-indicators

	Business Type	Convenient	Public image	Popularity	Quality of service	Security	Charges	The quality of personnel	Environmental Facilities
Overall satisfaction	0.893	0.351	0.872	0.843	0.826	0.531	0.346	0.016	0.152

Table 7. The sub-adjusted correlation coefficients between dissatisfaction and sub-indicators

	Business Type	Convenient	Public image	Popularity	Quality of service	Security	Charges	The quality of personnel	Environmental Facilities
dissatisfaction	0.383	0.901	0.310	0.392	0.401	0.55	0.832	0.863	0.792

By division of the middle groups, we can see that correlation coefficients between the overall satisfaction and sub-indicators is more clearly ,which illustrates the existence of fault among the middle groups, so satisfaction and dissatisfaction can be divided into two independent entities.

We can draw from the above two tables: types of business, public image, reputation and service quality as the motivating factor; convenience, fees, quality of personnel, environment and facilities as maintaining factor. And due to China's state-owned banks belong to state, as support from the national credit, the security is not given much thought to the customer in mind. With changes in consumer attitudes, consumers increasingly pay attention to the improvement of banking environment and facilities, the bank staff attitude and bank charges, so these indicators can not meet consumer expectations, consumers will have a greater discontent, However, because of each bank policy and historical reasons, the current situation for these indicators are similar, so even if improved these indicators, we can not easily increase high consumer satisfaction. Lack of The types of business, convenience, public image, reputation and service quality and other indicators will not result in greater consumer dissatisfaction, and each bank still has room for innovation, improvement of these indicators can help improve customer satisfaction further improved.

5 Conclusion

In the current environment of restructuring of commercial banks, to win customers effectively become a vital task, customer satisfaction has become the focus of major

banks. All banks are do great efforts from all impacts to increase consumer satisfaction, in order to enhance their attractiveness to consumers, and ultimately have a favorable position in the market competition. At this point the distinction between incentives and maintaining factors will help banks to effectively use resources to seize the key, to preterm goals. Maintaining factors should be at or slightly above the industry average, and in the incentives banks should focus on innovation to improve customer satisfaction.

Banks should recognize that, with changes in the environment, the importance of each factor in consumers' mind will change, and technological breakthroughs will make the realization of certain functions easier, thereby enhancing the importance of certain attributes, or reduce some of the attributes, to form the dynamic change between incentives and maintaining factors. Through the satisfaction research we know a clear focus, which ensure the bank's efficiency and effectiveness, and ultimately ensure that the bank's competitive advantage in the market.

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Implementation of Minicluster Parallel Computing Environment

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Abstract. Nowadays parallel computing has been applied in more and more fields, The Linux-based PC cluster is a cheap and efficient parallel computing system. The software and hardware environment in building clusters was introduced, including the construction of nodes, selection of operation system, SSI, and construction methods of MPI parallel environment. The cluster is implemented with several PC in the lab, the detailed process of software configuration is also provided, the programming condition is provided for parallel calculation on the cluster.

Keywords: Parallel Computing, Linux Cluster, Cluster building, Single System Image.

1 Introduction

Along with the computer application is becoming more and more complex, the computation speed of the growing demand. How to meet the requirements of scientific computing, quickly and effectively improve the calculation speed become computer science one of the urgent problems. To solve this problem the most rapid and effective method is to link computers together constitute the cluster parallel computing system, which allows them to cooperative solving the same problem. Cluster system has the advantages of low cost, high performance and scalability, and other significant advantages, the use of cluster system build prototypes, debugging, running parallel applications instead of expensive parallel computer platform has become the development trend of high performance computing. For a particular field of study, the small PC cluster system is capable of providing a serial computer systems incomparable efficient platform.

This paper constructs based on the Linux operating system of the small cluster system is a low-cost, high performance parallel computing system, applicable to the general scientific research institutes to carry out parallel computing application.

2 Hardware, Software Environment Settings

A small PC cluster system includes hardware, software environment settings of two parts. For the hardware environment settings, which involves computing nodes and the network equipment standard hardware can be found in the computer company to buy,

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easy to achieve. Software environment settings including cluster operating system, the choice of cluster job management system and parallel programming environment settings [1], construction is relatively complex.

2.1 Hardware Environment

The hardware is selected by users of the cluster system function, performance, price to decide, need to consider node computer and Internet network from two aspects: the choice of.

2.1.1 Node Computer

Cluster system composed of a plurality of node computer, computer workstations, nodes can be ordinary PC machine, the blade type or frame type server. According to the node in the cluster can be divided into six categories [2]: user node is the external access cluster system the only entrance, users typically logged on to this node to compile and run the operation; control node for computing node to provide the basic network services and scheduling on the compute nodes of homework, usually cluster job scheduling program running on this node; node cluster system management is various management measures of control nodes, each node in the control group and the status of network operations; storage nodes in cluster system is the data memory and the data server. If the cluster system running applications that require large amounts of data, we need a storage node; node cluster system installation installation of various software, including the operating system, all kinds of runtime library, management software; computing node is the entire cluster computing core, its function is to perform the calculation, according to the specific needs and budget to decide what kind of calculating node configuration.

According to the actual situation, the user node, the control node, the management node, the storage node and the nodes can be the same computer, that is the whole cluster master node. Other nodes only bear computational tasks, cluster computing node. Cluster by a plurality of compute nodes and a master node form, in order to facilitate the replacement, load balance and performance analysis, select the node computer should be very similar.

2.1.2 Interconnection Network

Establishment of a small PC cluster is a key link in the system is the use of the Internet will all nodes are connected into a whole system. At present the main network technology with Ethernet, Myrinet, InfiniBand etc.. Ethernet access convenient, high reliability, and low price and good performance, is ideal for small cluster system. Myrinet is produced by Myricom company is currently the highest price-performance Gigabit switch network, is used to construct the SAN cluster or desktop system based on LAN. Myrient Internet speed was faster than Ethernet, but the price is high. InfiniBand technology is a kind of new I/O system bus, network technology, can replace PCI as the system bus, it will become the next generation of I/O nodes, between processor nodes interconnected by a high speed mode [3]. Because of the special computing cluster system for the general scientific research units and school construction, so the choice of economical and practical Ethernet, using twisted pair by

NIC and the switch of each node PC computer local area network interconnection become.

2.2 A Small Cluster System Environment Settings

2.2.1 Cluster Operating System

The current cluster system common operating system with LINUX, UNIX, Windows series and Mac OS. UNIX system is a high-end server and workstation in common use of the operating system, its stable operation, safety is better. Linux is a class UNIX UNIX operating system, it has various advantages, has been developed into a high performance, high reliability of the operating system, can be associated with a variety of commercial operating system comparable to. In addition, in the Linux platform has some excellent open source code software, with numerous software development support, in previous research on the basis of further research and development.

2.2.2 Single System Image Construction

Single system image (Single System Image, SSI) is a system of only one operating system image stored in memory, but just feel, like a single system. Using SSI the main purpose is to make the construction, small cluster system in use, control, management and maintenance as a workstation, as the use of a powerful computer. A small cluster system of single system image SSI should provide the following services:

⑴ It can realize the single user login

What say here" single sign-on" refers to a user from the cluster system in any one node login, and in the entire parallel job execution process does not need to login second times, even if the operation is assigned to other nodes without logging in again. Single sign-on can network information system (Network Information System, NIS) and Shell script way to achieve. Can be achieved through NIS network multiple hosts to the sharing of resources, so that the whole network as a separate system. Shell for the management of user and the operating system interaction, but also to provide users with the means of communication operating system.

⑵ The single file system

On the same cluster system, some of the same software does not need to be repeated for installation, and some parallel operations on each node can access. Network file system (Network File System, NFS) is a kind of Unix / Linux through file sharing network in the standard manner, using it to transparent installation and access networks to remote server file system.

⑶ The single operation management system

Requirements of users can transparently in any node of submitting a homework, homework to batch or interactive, parallel mode.

2.2.3 Parallel Programming Environment Construction

Message passing model, shared variable model and data model is the present commonly used programming model, different programming models need different programming environment. Message passing interface standard MPI (Message Passing Interface) is the most popular distributed memory parallel programming environment. The main purpose is to improve the parallel program portability and ease

of use. According to the unified standard, parallel computing environment application software and software tools can be transparent transplantation. MPI is a library, is a kind of standard, the MPI and Fortran language, C language bindings. MPICH is composed of the United States of America Argonne National Laboratory Development Based on the MPI standard is a set of open source packages, the most recent version is MPICH2-1.0.7 [4].

3 Small Computing Cluster System

3.1 Hardware Requirements

Here the cluster as small computing cluster system, need five PC computer and Internet connection, wherein the PC computer is set as the master node, the main task is to complete the cluster system management work, is also involved in the operation, it is the computing node. The other four PC computer from node, is what we call the computing node. The user can conveniently increase the number of nodes, the scale expanded trunking system. Each node configuration requirements for: node0: the master node, Pentium R D CPU 2.80GHz processor, memory, hard disk 2.0GB 320G, IP address: 172.18.63.220. Node1-4: Pentium D CPU page from the node, processor, memory, hard disk 2.80GHz 1GB 80G, IP address: 172.18.63.221 - 172.18.63.224. The economic utility of relatively inexpensive Ethernet, with twisted pair by NIC and the switch node computers local area network [5].

3.2 Software Configuration

3.2.1 Operating System

Because LINUX has the advantages of high performance, high reliability and open source code and other characteristics, this paper constructed a cluster system will use LINUX operating system, using RedHat Linux 9.0.

3.2.2 Single Sign-On Configuration

Through the NIS script and Shell way to achieve single login, users no longer repeat input password to log on to another node in the cluster. Steps are as follows:

(1) The root user login to the cluster master node node0, edit the file / etc / hosts, / etc / host.equiv, in which to write all nodes of the cluster name and IP address.

(2) The start the following system service: NFS, rexec, RSH, rlogin. The three back in the remote node service responsible for starting the process, and Remote Shell related.

(3) It started as a regular user command $ESH node0, test whether RSH configuration successfully. For root users, run the following command configuration:

```
# echo “rlogin” >> /etc/securetty
# echo “rexec” >> /etc/securetty
# echo “rsh” >> /etc/ securetty
```

So that the root user may not re-enter the password to log in via RSH remote node.

3.2.3 Single File System Configuration

At the master node node0, create the directory / cluster, the directory / home and / cluster as global shared directory, the global file storage, so that each slave node sharing, from the node, modify partition configuration file fstab, loaded at startup time main node of the global shared directory. Set the following steps:

(1) On the master node node0 create the directory / cluster, then the directory authorization for user cluster.

```
# mkdir /cluster
# chown cluster : cluster /cluster
```

(2) Through the server setting tool configures the NFS server to set the shared directory, also can directly modify the / etc / exports file change directory share. The directory / home and / cluster to read and write the way to share to 172.18.63.0 / 24 (IP address: 172.18.63.1 ~ 172.18.63.254) all the computers.

```
# /sbin /chkconfig nfs on
# /sbin /chkconfig nfslock on
# /etc / init.d/ nfslock restart
# /etc/init.d/ nfs.restart
# vi /etc/exports
/home      192.168.0.0/24(rw,async,no_root_squash)
/cluster   192.168.0.0/24(rw,async,no_root_squash)
```

(3) Run the command exportfs - A, the complete catalog of sharing.

(4) The client node also need to establish the directory / cluster, and then modify partition configuration file, / etc / fstab, and add on / home and / cluster mapping:

```
node0:/home   /home   nfs   defaults    0   0
node0:/cluster /cluster nfs defaults   0   0
```

(5)Run the command mount - A, the complete catalog of sharing:

```
# /sbin/chkconfig   netfs   on
# mount –t   nfs   –a
```

3.2.4 Single Operation Management System Configuration

The following is to install the NAS (National Academy of Sciences) developed a batch job scheduling and resource management system open source software package OpenPBS operations management system step by step:

(1) The decompressing installation file packet, using configure script in the initial configuration.

- prefix / pbs_home specified for installation directory; - set-server-home specifies the OpenPBS spool directory, stored for each daemon configuration files, log files and task scheduling of temporary data. -- set-default-server specify the cluster operating system service daemon (Job Server) at the node node0.

```
# tar zxf OpenPBS_2_3_16.tar.gz
# cd OpenPBS_2_3_16
```

```
#/configure --prefix=/pbs_home/
--set-server-home=/pbs_home/spool  --set-default-server=node0
```

(2) The use of make, make install OpenPBS installation.

```
# make
# make install
```

(3) Modify server node node0 OpenPBS configuration file specified in the parallel running environment in the node name.

```
# cd  /pbs_home/spool/server_priv/
# vi  nodes
 node1
 node2
 node3
 node4
```

(4) By setting the customer node configuration file to determine the log file format and a server node name.

```
# cd /pbs_home/spool/mom_prive/
# vi config
 $ logevent 0x1ff
 $ node0
```

(5) The completion of the basic configuration, start the client node OpenPBS waiting process.

```
# /pbs_home/sbin/pbs_mom
```

(6) Start the server node on the three waiting process. On the pbs_server start first need to add the t create parameter.

```
# /pbs_home/sbin/pbs_mom
# /pbs_home/sbin/pbs_sched
# /pbs_home/sbin/pbs_server -t create
```

3.2.5 Parallel Programming Environment Configuration [6]

Download MPICH2-1.0.7 software package to the directory / cluster, its configuration steps are as follows:

(1) The decompressing installation file packet and through the configure script has completed the initial configuration.

The - prefix / cluster / MPICH specified for installation directory; -- with-device specify the use of the communication system for the type of TCP / IP communication system; with-arch specified for use by the operating system for Linux.

```
# cd /cluster/
# tar zxf mpich.tar.gz
# cd /cluster/mpich2-1.0.7/
```

#./configure --prefix=/cluster/mpich --with-device=ch_p4 --with-arch=LINUX

(2) The use of make, make install MPICH installation.

make

make install

(3) Edit the. Bashrc file to set environment variables, in which the added: PATH =" $PATH : / cluster / mpich2-1.0.7 / bin", with the following command test environment variable setting.

which mpd

which mpicc

which mpiexec

which mpirun

(4)Create the file / ECT / . Mpd.conf, joined the secretword = HGD, setting the file modification time and read permission:

touch /etc/. mpd.conf

chmod 600 /etc/. mpd.conf

(5) Modification of the MPICH node configuration file / cluster / MPICH / shar / machines.LINUX, indicating that the cluster contains the node.

(6) Create host name collection file / root / mpd.hosts, file:

node 0

node 1

node 2

node 3

node 4

(7) Cluster system：

mpdboot -n number -f mpd.hosts

mpdtrace

mpdallexit

(Number said to start the computer number)

(8) In the installation directory, subdirectory example can find the sample source code, to run through the compiler CPI program can test the MPI programming environment is established successfully.

4 Conclusion

This article introduced in the Linux environment using PC algorithm. A small cluster system, cluster system can realize single sign-on, single file system, single operation management system and parallel programming environment, has low cost of hardware practical economic advantages, for the general scientific research units and institutions

in the cluster to carry out parallel programming provides a practical software and hardware environment.

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Empirical Study on Factors Influencing of University-Enterprise Technology Transfer*

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Abstract. University-Enterprise technology transfer is not only the important way to realize the scientific research value and promote enterprise competitive advantage, but also a pattern to push on the development of area and national economy. This paper brings forward conceptual model and interrelated hypotheses on University-Enterprise technology transfer, and discusses the key influencing factors of University-Enterprise technology transfer through the expert questionnaire, using the factor analysis, single factor analysis of variance and so on.

Keywords: university-Enterprise technology transfer, influencing factors, empirical study.

1 Introduction

Integrate scientific and technological resources as a whole is the key to realize the technology innovation and economic development, The State Council has approved the establishment of national co-ordinating technological resources comprehensive reform pilot area in Xi'an, the key aspect is the effective integration between two subjects: businesses and universities. But how to improve the enterprise technology innovation level become the key factor to determine their overall competitive strength, for this our country promote the combination of technology transfer by establishing the research alliance, but the results are not satisfactory, the important reason is that the behavior between technology transfer subject are influenced by many complicated factors. Whether through the improvement of the key factors to promote the practice of university-enterprise technology transfer is a beneficial exploration path. Hemmert (2004) and others studied on the influence of university-enterprise technology transfer from the technical characteristics, the transfer subject, transfer channel and environment etc. Lin Fengqi and Zhang Yan(2007), also analyzed the influencing factors of university-enterprise technology transfer from different perspective, but special research about the influencing factors of university-enterprise technology transfer characteristics is still rare. The paper summarizes the relevant research literature and establishes the influencing factors model, and then through the experts' investigation method, using statistical method to verify the key factors, in order to discuss the countermeasures to promote the university-enterprise technology transfer.

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2 Analysis on Influencing Factors of University-Enterprise Technology Transfer under Perspective of Integrating Scientific and Technological Resources

From the subject, direction, purpose, method and process of technology transfer, etc, technology transfer can be defined as: technology in different areas and organizations, the supplying and receiving process of technical resources from a technology owner to the technology demanders, in which process with the flow of other resources such as money, equipment, person, time and so on, can take different realization way such as cooperation and guidance, its purpose is to get economic benefits, the political benefits or social benefits. Specific to university-enterprise technology transfer, the process make the university technology achievements production, commercialization, and industrialization, and finally realize the market value. Summarizes the domestic and foreign literature, combined with the characteristics of university-enterprise and practical transfer, influencing factors can be attributed to five aspects such as the characteristics of external environment, the technology subject, characteristics of technology itself, technical market support and information resource utilization.

2.1 Characteristics of External Environment

Hemmert(2004) through the empirical study found that political, legal and economic factors has different effects on technology transfer. Li Wenbo(2003) thought that the political, economic and geographic location and other factors have obvious influence on technology transfer. Sun Liwen (2008) thought that better legal environment, economic environment, industry-university cooperative environment and social service environment can make the mode selection of university-enterprise technology transfer more freedom, and the transfer effect more obvious.

2.2 Characteristics of Technology Transfer Subject

Lin&Berg(2001) found that the ability of the supplier to some extent determine the maturity of the technology, and more mature technology can make better transfer results, more perfect technology human resources can make better technology transfer results. From the factors involved in the technology knowledge transfer process, In addition, Chen Yun(2004) through the empirical research proved that the research and development ability is better, the transfer effect would be better. Recently, Zou Yan(2009) proposed transfer aspiration, incentive mechanism and the corresponding evaluation system has a positive effect on technology transfer.

2.3 Technical Characteristics

Ranft&Lord (2002) through the case study found that the technical knowledge is more implicit, the knowledge transfer is more difficult. Chen Xiaoxian(2004) thought that tacit knowledge in technology have greatly increased the transaction costs, and bring greatly hidden danger to the receiving party management, which will lead to the failure of the technology transfer transaction. Meanwhile, Yong Suhk&Young-ryeol (2004) found that the complexity of the technical knowledge and has a significant negative

effect on the technology transfer. Wu Xiang(2009) studied on the impact of the viscosity and the embedded nature of technical knowledge to the realization of the technology transfer.

2.4 Technology Marketing Support

Yong&Lan(1997) found that technology supplier motivation, transfer channel, the funds of receiver and related agency support have a effect on technology transfer. Hu Jinyou(2009) thought that the technology acquisition effect of enterprise is influenced by many organizations factors, including the difficulty degree of obtaining the technology from external enterprise, the support of intermediary institutions, policies and regulations and financing environment, etc.

2.5 Information Resource Utilization

Tatikonda&Stock(2003) proposed the interactions between organization can help reducing the uncertainty in the process of technology transfer, these factors can be integrated into three dimensions: the organizational communication, coordination and cooperation. Zhou Fenghua and Zhu Xuezhong(2006) thought how rich of science and technology resources and its using have a effect on the technology transfer result. Lin(2007) put forward science and technology information circulation differences between strategic alliance interaction mechanism and strategy partner is important influence factors of technology knowledge transfer.

3 Research Model and Hypothesis

Based on the summary of literature research, this paper will research the influence of external environment, the R&D capabilities of technology transfer, the transfer aspiration, the absorptive capacity, and the obtain aspiration on effect of the technology transfer, and study the influence of technology characteristics on effect of the technology transfer from the two respects: recessive and complexity. The influence of intermediaries support and financial security have a positive effect on the technology transfer; The information circulation, communication and interaction, and transfer experience in the information resources have a significant positive effect on the technology transfer. Combining with literature and concept model proposes the following hypothesis:

(1)The hypothesis based on macro-environment: H1 The science and technology development has a positive significant effect on university-enterprise technology transfer; H2 Economic operation has a positive significant effect on university -enterprise technology transfer.

(2)The hypothesis based on micro environment: H3 The R&D capabilities of the transfer supplier has a positive significant effect on university-enterprise technology transfer; H4 The transfer aspiration of the transfer supplier has a significant positive

effect on university-enterprise technology transfer; H5 The absorptive capacity of the receiving party has a positive significant effect on university-enterprise technology transfer; H6 The obtain aspiration of the receiver has a significant positive effect on university-enterprise technology transfer; H7 The recessive of technology has a negative effect on university-enterprise technology transfer ; H8 The complexity of technology has a negative effect on university-enterprise technology transfer.

(3)The hypothesis based on medium environment: H9 The policies and regulations of technical market has a significant positive effect on university- enterprise technology transfer ; H10 The mediation support has a significant positive effect on university-enterprise technology transfer ; H11 The financial security of technical market has a significant positive effect on university- enterprise technology transfer ; H12 The information circulation has a significant positive effect on university-enterprise technology transfer ; H13 The communication and interaction has a significant positive effect on university-enterprise technology transfer ; H14 The transfer experience of the two sides has a significant positive effect on university-enterprise technology transfer.

4 Data Analysis and Model Verification

Through the expert questionnaire survey to investigate the science and technology innovation fruitful of many universities and high-tech enterprises of Xi'an High-tech Zone in Xi'an area. After making some appropriate perfect, then do a formal investigation. The whole of survey questionnaires are 185 copies, the total recovery questionnaires are 179 copies, among them university questionnaire are 75 copies, high-tech enterprises are 104 copies, the response rate of the questionnaires is 96.75%, of which the effective questionnaire are 176 copies, the effective rate is 98.32%.

4.1 Reliability Analysis

The research estimate the scale reliability by internal consistency coefficient, usually using the project-based covariance methods to estimation, the survey results of reliability analysis, including the consistency coefficient alpha are in table 1.

The reliability analysis results show that the variable reliability coefficient are in more than 0.8, the total scale reliability coefficient is 0.827, which indicate the scale reliability of the research is very good, and meet the need of the research.

4.2 Validity Analysis

(1)Construct Validity: The relevant items of questionnaire are measured by the factor analysis, the results are in Table 2. Total variance explained quantity is 72.635% more than 60%, so the construct validity of the questionnaire is acceptable.

Table 1. Variables constituent and reliability analysis results

Variable Name	Symbol	Number	α
STD	A	4	0.808
EO	B	1	0.811
PR	C	4	0.812
FS	D	4	0.812
MS	E	4	0.825
IC	F	3	0.811
CI	G	3	0.834
CT	H	3	0.801
RT	I	3	0.808
RDC	J	4	0.807
TA	K	4	0.814
TE	L	1	0.827
AC	M	3	0.820
OA	N	3	0.803
ETT	O	3	0.851

STD=science and technology development, EO=economic operation, PR=the policies and regulations, FS=financial security, MS=mediation support, TE=the transfer experience, IC=the information circulation, CI=communication and interaction, CT= the complexity and recessive of the technology, RT= the recessive of the technology, RDC=R & D capabilities, TA=transfer aspiration, AC=absorptive capacity, OA=obtain aspiration, ETT=effect of technology transfer

Table 2. Summary of factor analysis results

Type of environment	**Independent Variables**	**KMO**	**Total variance explained quantity**
Macro-environment	STD, EO	0.797	79.153%
Moderate-environment	MS, FS, PR, IC, CI, TE	0.681	70.711%
Micro-environment	CT, RT, RDC, TA, AC, OA,	0.703	68.157%
Dependent Variable	ETT	0.721	73.715%

(2)Content validity: Based on the summary of the literature, through content analysis and comprehensive depth interview, we proposed the influencing factors and measure dimensions in this scale. After analysis and research, the questionnaire was revised and its validity can be guaranteed.

5 Hypothesis Testing

5.1 Testing of Control Variables

This study through the single-factor analysis of variance tests the enterprise industry characteristics and the capital size on the effect of technology transfer respectively. The mean relationship of different industries on the technology transfer effect is: Chemical industry, textile and mechanical manufacturing industry>Biological medicine and new materials industry>other industries>IT and communication equipment manufacturing industry. Through the homogenity of variances test, the result show that found the Variance of inspection value is 1.129, P=0.346>α=0.05, which shows no significant difference in the population variance; Second, the single factor variance analysis of the industry characteristics showed F=10.489, P=0<α=0.05, which fully explain the industry characteristics has a significant effect on the technology transfer.

The mean relationship of capital size on technology transfer effect is: 500-1000 million>More than 10 million>50 million or less>200-500 million>50-100 million>100-200 million. Through the homogenity of variances test, the result show that the Variance of inspection value is 4.873, P=0.002<α=0.05, which shows a significant difference in the population variance, don't meet the precondition of the analysis of variance, and the single factor variance analysis showed F=1.451, P=0.224>α=0.05, fully explain the capital size has not a significant effect on the technology transfer.

5.2 Results of Hypothesis Testing

The technical ability, transfer and obtain aspiration for 14 variables as independent variables, the effect of technology transfer as the dependent variable, testing hypotheses are established or not through multiple linear regression, the regression results are in Table 3.

In the study, regression model VIF values are in between 0-10, multicollinearity problem does not exist; Regression model DW value is 1.932 close to 2, there was no serial correlation problem; the technology transfer effect as abscissa make the scatter plot analysis of residuals, the scatterplot chart is disordered state, so there was no heteroscedasticity problems in all regression models.The regression results showed that adjusted coefficient of determination R2=0.926 close to 1, indicating a high goodness of fit, the regression equations can explain 92.6% of the total variation; At the same time F=2.981, P=0.001<0.05, reached a relatively significant level.

Science and technology development, R&D capabilities, transfer aspiration and interaction, the regression coefficients are in 0.05 level significantly different from 0, and their respective standardized regression coefficients are positive, which show these variables have a significant positive effect on the technology transfer in conformity with the hypothesis H1, H4, H5, H7, H8, H11, H12 and H14, while the situation of economic operation, the policies and regulations, the transfer experience, the information circulation P>0.05, which show these variables have no significant positive effect on the technology transfer, therefore it does not support the hypothesis

Table 3. Results of the regression analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
constant	0.393	0.177		1.148	0.054		
STD	0.636	0.164	0.638	0.142	0.009	0. 537	1.863
EO	-0.013	0.120	-0.014	-0.108	0.914	0.532	1.881
PR	-0.031	0.176	-0.023	-0.178	0.859	0.579	1.727
FS	0.787	0.189	0.793	1.065	0.021	0.476	2.103
MS	0.671	0.119	0.674	1.441	0.034	0.675	1.482
TE	0.095	0.132	0.092	0.735	0.465	0.605	1.652
IC	0.092	0.173	0.093	0.535	0.596	0.312	3.781
CI	0.631	0.133	0.642	0.100	0.021	0.265	3.220
CT	-0.688	0.175	-0.671	-0.504	0.016	0.478	2.094
RT	-0.565	0.143	-0.551	-2.556	0.013	0.501	1.995
RDC	0.748	0.221	0.756	3.377	0.001	0.349	2.862
TA	0.610	0.288	0.607	0.253	0.021	0.614	1.630
AC	0.658	0.157	0.676	1.008	0.017	0.453	2.208
OA	0.597	0.176	0.594	3.389	0.001	0.464	2.155

H2, H3, H6 and H13. The regression coefficients of the recessive and complexity of the technology are negative, indicating the complexity and recessive of the technology have significant negative effect on the technology transfer in conformity with the hypothesis H9 and H10.

6 Discussion and Implications of the Research Results

6.1 Discussion

Research through the single-factor analysis of variance analysis enterprise industry characteristics and capital size on the effect of technology transfer, The results show that the industry characteristics has a significant influence on the effect of technology transfer, and the capital size has not a significant effect on the effect of technology transfer. The paper test and verify the research hypotheses by regression analysis, The results show that the Verification results of the economic operation situation of the environment characteristics, the policies and regulations of the technology market, the transfer experience of the information resources and the information circulation are inconsistent with the original hypothesis, the reasons are as follows:

(1)The economic operation situation of the environment characteristics does not pass the verification. The results show that the economic operation has not a positive significant influence on technology transfer. Mainly due to the good or bad of the economic operation have a significant influence on international technology

transfer, while the influence on University-Enterprise technology transfer within the area is not obvious.

(2)The policies and regulations of the technology market does not pass the verification. Mainly derived from the current domestic technology market itself mechanism imperfect, the legal system construction is not sound lead to the enterprises have not enough attention to the effect of technology transfer, and also for the corresponding policies were not implemented lead to the technology subject do not believe and not clear the technology transfer effect in the whole process of technology transfer.

(3)The transfer experience and the information circulation of the information resources do not pass the verification. The results show that the transfer experience has not a positive significant influence on technology transfer. Mainly due to the both have technology transfer experience are outdated, they can't accept with the original technology transfer ways in the technology transfer process. But also because the technology subject are failing to make full use of information resources, resulting in the poor communication and understanding between the both of them, and communication and interaction has a positive significant influence on technology transfer just to illustrate the point.

6.2 Revelation

The statistical results show that science and technology development, R & D capabilities, transfer aspiration, absorptive capacity, obtain aspiration, financial security, mediation support and communication and interaction have positive significant influence on technology transfer. Among them, the influence of the technology transfer subject characteristics and financial security are more obvious. This can obtain the following revelation.

(1)The powerful research capabilities and talent advantage are underutilized. Many scientific and technological achievements are in "dormant", due to a lack of effective incentive mechanism and transfer underpowered. Therefore, it should improve the incentive mechanism of the scientific research institutions to promote their strong transfer will. For enterprises, should increase R&D investment, introduce the technical talents, conduct production-teaching-research combination and other cooperation ways to enhance the absorption capacity.

(2)**Science and technology achievements and science and technology enterprise development face the one of the biggest problems is the financing difficulties.** Currently, financing channels are too small to guide the enterprise enter into the technology transfer obviously, therefore, it should improve the financing environment in the technology market, support for the innovation of the financial product and service organizations and increase funding for the technology transfer.

(3)**Establish a good communication and interactive mechanism to facilitate of the success of technology transfer.** For enterprises, they should establish a good innovation cooperation mechanism with universities and strengthen scientific management in the communication and interaction process.

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Investigation of Current Situations of Uygur People's Mass Sports in Xinjiang

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Abstract. Investigation and analysis of current situations of urban and rural Uygur residents' participation in the traditional sports activities in Xinjiang were made through questionnaire investigation and interview investigation, finding 57% of Uygur residents often participate in one of sports activities " at least three times per week", with the time for each event over one hour. Of the traditional sports activities, horseback events account for leading proportion, mainly including horse racing, Sheep Snatching on Horseback, Girl's Chasing and Qielixi (a local game), etc. In terms of main places for the sports activities, "public sports place", "employers' sports facilities" and "family courtyard or indoor areas" are most frequently selected. Shortage of sports field and no enough time for exercise are main reasons influencing and restraining the residents' participation in the traditional sports activities. Changing living idea, living environment and economic conditions and popularization of modern refreshment and entertainment mode and competitive sports have made big impact on carry-on and development of traditional sports activities of the ethnic monitories.

Keywords: Uygur, mass sports, investigation, Xinjiang.

Mass sports, an important part of modern sports, co-existing with competitive sports, means a social and cultural practice that is carried out widely by social members in spare time, with body action as the main approach and improving health level and enjoying entertainment and recreation as the main goal, with a view to constantly surpassing the self and promoting social betterment in material and civilization on the basis of all-round development of body and mind health. With implementation and popularization of Outline of the Nationwide Body-Building Plan and social betterment, people's awareness of health keeps deepening, and keeping fitness by participating in sports has become a consensus. This paper, through sampling survey of Uygur people in Xinjiang, gains factors of Uygur people's participation in mass sports, such as the current situations, characteristics, influencing conditions and development trend, etc.

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1 Study Object and Method

1.1 Study Object

498 urban and rural Uygur residents from Kashi, Turpan and Urumqi of Xinjiang were selected as the study object in this paper.

1.2 Study Method

Questionnaire investigation method, interview investigation method, mathematical statistics method, documentary data method.

2 Investigation Result and Analysis

2.1 Basic Situations of the Uygur Residents Investigated

1) Urban and rural Proportion： 239 urban residents, 48.0% of the total; 259 rural residents, 52.0% of the total.
2) Gender structure：M: 275, F: 223, M:F is 55.2% ：44.8%.
3) Age structure：to be remade

2.2 Basic Situations of Uygur Residents' Participation in Sports Activities

The investigation shows that 57% of the Uygur residents participate in sports activities "at least three times per week", while 43% of the residents "less than three times per week", which is mainly due to quickening work tempo's influence on distribution of spare time. In terms of activity time arrangement, 76.7% of the Uygur residents "have at least 30 minutes for one of sports activities", while 23.3% of the residents "fail to reach 30 minutes for one of sports activities".

1) Place for Uygur Residents to Participate in Sports Activities
In terms of selection of main places for sports activities, choices include "public sports place ", "employer's sports facilities", "highway/street side", "wood, river/lake, grassland ", "family courtyard or indoor area", "open space in residential community", "park, square", "courtyards ", " paid stadium/gym" and "other places".

2) Form of Uygur Residents' Participation in Sports Activities
Selection of form of sports activities is shown as Table 3 in turn："doing exercise together with friends/colleagues", "joining employer-organized exercise ", "self exercise", "participating in activity organized in the community", "doing exercise together with families", "doing exercise in sports guidance station/club".

3) Events of Sports Activities That Uygur Residents Participate In
Selection of events of sports activities is shown as Table 4 in turn："long walking, jogging", "football, basketball, volley-ball, etc", "table tennis", "snock, bowling",

Table 1. Age Structure of the Uygur Residents Investigated

Age （years old）	16-25	26-35	36-45	46-55	56-65	Older than 65
Number	109	147	133	58	27	24
%	21.9	29.5	26.7	11.6	5.4	4.8

Table 2. Place for Uygur Residents to Participate in Sports Activities

Activity place	Proportion %
Public sports place	47.7
Employer's sports facilities	22.1
Highway/street side	15.1
Wood, river lake, grassland	15.1
Family courtyard or indoors	12.8
Park, square	11.6
Open space in residential community	11.6
Courtyard	9.3
Paid stadium/gym	3.5
Other places	3.5

Table 3. Form of Uygur Residents' Participation in Sports Activities

Form of participation in sports activities	**Proportion %**
Doing exercise together with friends/colleagues	45.3
Joining employer-organized exercise	32.6
Self exercise	31.4
Participating in activity organized in the community	20.9
Doing exercise together with families	16.3
Doing exercise in sports guidance station/club	5.8

"badminton", "swimming", "various exercises", " mountain climbing", "jump rope", "activities with fitness equipment", "tennis ", "going to folk dance", "practicing Qigong and TaiChi", "going to social dance, dance sport", "others ", "ice and snow activities " and "Wushu". No one has selected "ground-casting ball" or "gateball".

4) Times of and the Highest Ticket Price for Uygur Residents' Visit to Sports Places in a Year

The investigation shows that the average of Uygur residents' visit to paid stadium/gym for exercise and entertainment is 5.25 times and that the affordable highest ticket price is 43.57yuan per times per person.

5) Reasons Why Uygur Residents Participate in Sports Activities

In terms of selection of reasons for sports activities, the choices are as follows in turn : "building up health", "refreshment, recreation, entertainment", "improving self sports skills", "a communication with friends and companions", "falling into the habit of sports activities", "for cultivation and improvement of spirit and mood", "feeling sports insufficient", "beauty, losing weight, body building", "enhancing social ties, keeping contacts with families", "other reasons", "accompanying children to participate in sports activities ".

Table 4. Reasons for Not Participating in Sports Activities

Reason for not participating in sports activities	Proportion %
Short spare time	53.6
Heavy work burden, very fatigued body and mind	43.9
No interest	34.5
Insufficient economic strength	15.5
Ground for exercise is far, inconvenient	14.6
Poor health, unsuitable for sports	9.5
No special reason	8.5
Do not know sports skills and how to do exercise	6.8
Did not like sports activities even as a student	6.3
No sports facilities	6.3
Good health, don't need participation in the sports	4.6
Afraid of being ridiculed or not being understood	4.1
Other reasons	3.9
Sports activities are not suitable for personal behavior characteristics	3.6

2.3 Reasons Why Uygur Residents Do Not Participate in Sports Activities

Selection of reasons for not participating in sports activities is shown as Table 5 in turn : "short spare time", "heavy work burden, very fatigued body and mind", "no interest", "insufficient economic strength", "ground for exercise is far", "poor health, unsuitable for sports", "no special reason", "do not know how to do exercise", "did not like sports activities even as a student ", "no sports facilities", "good health, don't need participation in the sports", "afraid of being ridiculed or not being understood", "other reasons", "sports activities are not suitable for personal behavior characteristics ".

2.4 Problems That Must Be Solved for Participating in Sports Activities as Uygur Residents Think

In selection of the problems that must be solved for participating in sports activities, choices are as follows in turn : "having time", "ground and equipment available", "economic conditions available ", "instructor available", "with companions together for activities ", "others" and "overcoming self laziness".

3 Conclusions

3.1 The investigation shows that 57% of the Uygur residents participate in sports activities "at least three times per week", while 43% of the residents "fail to reach three times of sports activities per week", which is mainly due to quickening work tempo's influence on distribution of spare time. In terms of time for activities, 76.7% of the Uygur residents "have 30 minutes for one of sports activities", while 23.3% of the residents "have time for one of sports activities less than 30 minutes".

3.2 In selection of reasons for sports activities, 72.1% of the residents select "building up health", ranking No.1, which proves that Uygur residents have become aware of necessity of sports activities for building up health.

3. 3 Uygur residents mainly participate in sports activities in : "public sports place" and "employer's sports facilities"; main forms of sports activities : "doing exercise together with friends and colleagues", "participating in employer-organized exercise ", "doing exercise by self"; main events of sports activities : "long walking, jogging", "football, basketball, volley-ball, etc", "table tennis ", "snock , bowling " or "badminton ", etc.

3. 4 Main reasons why Uygur residents give up sports activities are: "short spare time" and "heavy work burden, very fatigued body and mind", which reflect the fact that quickening work tempo, increasing work pressure in modern social lives and decreasing people's living space have become the potential factors influencing people's health.

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Research Progress of the Basic Physical Properties of CO_2 Brine in the Sequestration of CO_2

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Abstract. Asses the capability and security of the sequestration of CO_2 in underground saline aquifer/seawater need high accurate data and models. Based on the existing data and models, this paper summarizes the progress on the density and solubility characters of CO_2 brine. It found that the range of temperature, pressure and salinity is likely to encompass a very large proportion of the environments that might be considered for the sequestration of CO_2, but the accuracy and the consistency of these data are not very well. And most of the models were congressed from experimental data which without fully take the solution composition or salinity factors into account, and have certain limitations in theory, do not satisfy the need of the sequestration of CO_2. So a systematic experimental data and a theoretical model with wide applicable range and high prediction accuracy are the basis of the sequestration of CO_2.

Keywords: component, the sequestration of CO2, density, solubility, prediction model.

1 Introduction

The increase of CO_2 concentration in the atmosphere has been considered as one of the greatest factors of global warming. To mitigate the accumulation of CO_2 in the atmosphere, CO_2 capture and storage have been widely investigated since the early 1990s. Zhang[1] reported that saline aquifer underground are considered as one of the most promising storage option for wide distribution and large storage potential. Depositional basins in our country distribute widely and formed multistory structure deep confined aquifer system at the center and lower basins. So it's meaningful to research CO_2 sequestration in deep saline aquifer in our country.

It is already known that density differences about 0.1kg m^{-3} are sufficient to develop negatively buoyant plumes on kilometer scale in weakly stratified environments Haugan and Drange[2], which is crucial for the natural transport of dissolved CO_2 to deeper water and then effect on capability and security of CO_2 sequestration. So it's necessary to obtain more experimental data and develop a high accurate model for the

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density prediction. The accurate solubility data of CO_2 in saline aquifer could evaluate the storage capacity of the underground reservoir. The research on CO_2 solubility is not only the need of geological sequestration but also very important to the carbonate deposition, Fluid inclusion and global carbon cycling at different temperature and pressure. The study on the basic physical properties of CO_2 brine system become more and more important with the development of CO_2 sequestration.

2 Experimental Data of CO_2 Brine

2.1 Density Distribution and Analysis of CO_2 Brine

There are many measurements on density of CO_2 brine have been reported. Most of the data felled in 0-200℃, 0-30MPa and covered the temperature and pressure range in practical reservoir conditions (30-150℃, 10-20Mpa) Song[3]. Some high-pressure data were reported by Gehrig[4]Schmidt[5], the other data were obtained below 30MPa; Nighswander[6]and Li[7] measured the densities of saline water saturated with gaseous CO_2, where the density data of Li[7] were determined for the Weyburn Formation brine, Gehrig[4] measured the density with CO_2 concentration up to 84.9 mol%; the composition of the salinity water included NaCl solution with different salinity Nighswander[6] Schmidt[5], the underground brine in different district Song[3]Li[7], and the synthetic seawater Song[8]Teng & Yamasak[9]; Gehrig[4] and Schmidt[5] reported the salinity for NaCl content were 20% and 40% respectively, the salinity in other papers were all below 8mol%. However, for the density of CO_2 formation brine solutions under practical reservoir conditions (high pressure, elevated temperature, and various salinities) more experimental measurements are required.

2.1.1 Density Change of CO_2 Brine with Pressure

As we known, the density of CO_2 brine increase linearly with pressure, and the increasing rate almost the same at a certain temperature and CO_2 concentration Song[3]Li[7]. Nighswander[6] measured densities of saline water saturated CO_2 with the salinity of 1wt% NaCl at 10MPa, the result showed that the densities of CO_2 saline water lower than CO_2 free saline water and independent with pressure. This result was disaccord with the conclusion that density increase with pressure discussed previously. It has relevant to the density change of 1wt% NaCl, for which density change is not obvious with pressure at lower pressure.

2.1.2 Density Change of CO_2 Brine with CO_2 Mass Fraction

The density of CO_2 brine increase with CO_2 concentration at a certain temperature and pressure Song[3]Li[7]. The slope of density with CO_2 mass fraction were the same at different pressure Li[7]; Song[8] reported density differences of CO_2 seawater solution with that of CO_2 freshwater solution, which is a linear function of CO_2 concentration and independent on pressure and temperature. The slope of this linear function is 0.273 g/cm^3 that was calculated by fitting the experimental data.

2.1.3 Density Change of CO_2 Brine with Temperature

Li[7]Song[3]reported that the density of CO_2 brine decrease with increase temperature. Song[3] reported some accurate ratios of CO_2-bearing seawater densities with respect to CO_2-free seawater densities, which increase with CO_2 mass fraction and neglect the effect of pressure, temperature and salinity.

Comments on the accuracy and consistency of these experimental data are scarce, and these data were found to have systematic deviations or large uncertainties. The density data of Song[8] for CO_2 seawater seem to be of high quality, but they did not report the densities of the CO_2–free seawater (3.5 wt % NaCl); Song[3] indicated that the experimental principle and accuracy of Nighswander[6] has some shortages which lead to the data errors. The analysis of hu[11] and song[3] concluded that the data reported in Li[7] has high quality. The other data also have similar quality problem.

2.2 Solubility Distribution and Analysis of CO_2 in Brine

The solubility data for the CO_2 brine system include those of Drummond[12], Nighswander[6], Rumpf[13] whose data covered a wide temperature, pressure and salinity range. Gehrig[15] measured the CO_2 solubility with NaCl concentration 1.09mol·kg^{-1} and the pressure up to 280MPa; Drummond[12]reported the most extensive data at low pressure; Teng & Yamasaki[9] measured the solubility of liquid CO_2 in Synthetic SeaWater at Temperatures from 278 K to 293 K and Pressures from 6.44 MPa to 29.49 MPa, and treated the liquid CO_2-water system as a one-sided solubility system, with liquid CO_2 as the solute and water as the solvent. However, the solubility of CO_2 in brine at high pressure(10-30MPa), medium temperature(40-120℃) and high salinity (most of data were within 4mol·kg-1) is still needed.

Besides, there are many researchers investigated the solubility of CO_2 in different salts with different electrolyte concentration. Yasunishi & Yoshida[17] reported the solubility of CO_2 in 16 different aqueous electrolyte solutions at 15℃, 25℃, 32℃at atmosphere pressure; Prutton & Savage[18] measured the solubility of CO2 in $CaCl_2$ solution at 75℃,100℃,120℃ and pressure 700Atm; Markham & Kobe[19] measured the solubility of CO_2 in nitrate, sulfate, chloride solutions and so on. There are more researches on NaCl solution, and we should study the solubility of CO_2 in various aqueous electrolyte solutions with wide electrolyte concentration for well simulate the complicated composition in practical saline aquifer conditions.

2.2.1 Solubility Change of CO_2 in Brine with Salinity

The CO_2 solubility is slightly reduced by inclusion of the salt, this has been reported in many papers Takenouchi & Kennedy[14] Nighswander[6].Nighswander[6] compared the solubility of CO_2 in 1% NaCl solution and water, the results showed that the solubility of CO_2 decrease with increase salinity at a certain temperature and pressure which is called salting-out.

2.2.2 Solubility Change of CO_2 in Brine with Temperature and Pressure

Li[7] measured the CO_2 solubility in Weyburn Formation brine (salinity is 8.36%) which showed the solubility increase with increase pressure, but the increment of solubility is decrease gradually with increase pressure. Gu[20] reported the solubility of

CO_2 in 0.5-2mol·kg^{-1} NaCl solution at 30-50℃, which also revealed a decrease phenomenon with increase temperature.

2.2.3 Solubility of CO_2 in Different Electrolyte Solution

Rumpf[13] reported that ammonium sulfate causes a much smaller salt out effect than both sodium sulfate and sodium chloride at a certain ionic strength and constant temperature. Yasunishi& Yoshida[17] measured the CO_2 solubility in 16 different aqueous electrolyte solutions, the results obtained in this experiment agree well with data reported in Markham& Kobe[19], Onda at 25℃.

There has been diversities in the experimental data observed because of the different experimental method and principle. The comparison between Harned& davis[21] and Markham& Kobe[19] indicated that: the solubility agree well at 0℃, yet the deviation is bigger at 25 ℃ and 40℃, which has not been stated with a reasonable explanation so far. The solubility in Drummond[12] showed a deviation between the increasing pressure and decreasing pressure process which reach to 8%-15%. There has no a reliable standard to ascertain the accuracy of these data, so more researches are needed in further studies.

3 The Models Research on CO_2 Brine System

3.1 Density Models of CO_2 Brine System

Some density models of aqueous CO_2 solutions are proposed by fitting the experimental data which called empirical models. Song[8],Song[3],Teng & Yamasak[9] presented models on the density of CO_2 aqueous solutions with CO_2 mass fraction by fitting their own experimental data. Duan[22] developed the model for the liquid CO_2–H2O–NaCl mixtures on the basis of his CO_2–H_2O model and the H_2O–NaCl model of Rogers and Pitzer. Where the average deviations of this model from the three experimental results of Song [23], Song [8], li[7] are 0.010%, 0.029%, and 0.026% respectively and the maximum deviations are 0.016%, 0.050%, and 0.075% respectively. The deviation of empirical model developed by Bando from the experimental data of Song[4] is within ±0.15%. The model of Song [8] correlated from their own density data gives the worst prediction of the density data of li[7] similarly.

There are large deviations of these models because of the simple regression from their own experimental data, where the effects of pressure, temperature and composition on density are not completely or properly taken into account. So the models existed has some theoretic limitation in the prediction of CO_2 brine system which could not meet the requirement in practical sequestration of CO_2.

3.2 Solubility Models of CO_2 in Brine

Models on solubility of CO_2 in brine has been investigated recently. The main research methodology were almost based on equation of state, activity coefficient and molecular simulation.

3.2.1 The Equation of State

Li & Nghiem[24] developed L-K model to predict the phase equilibrium of the oil, gas and water/brine (salinity up to 4mol·L^{-1}), which based on Peng-Robinson EOS, Henry's Law and the scaled-particle theory; Harvey & Prausnitz[25] developed the EOS of the CO_2 solubility in NaCl solution at high pressure. However, the comparison present that the L-N model did a poor prediction for the experimental data in Takenouchi & Kennedy[14] at 200℃, the errors exceed 10% and the deviation of the two models from the data reported in Takenouchi & Kennedy[14] increase with increasing pressure and salinity. Soreide & Whitson[26] developed the model to predict phase equilibrium based on the corrected Peng-Robinson EOS that usually used in liquid and gas, and the similar deviation existed when comparing the prediction results with the solubility data of CO_2 in Takenouchi & Kennedy[14]: the deviation up to 15% in 1 molNaCl solution at 150℃, 20MPa, where the deviation up to 20% in 2 molNaCl at 50℃ and high pressure.

3.2.2 Activity Coefficient

Duan[27] present a model covering a large T–P–m (0-260℃,0-200MPa, 0-4.3mol·L^{-1}) range in the CO_2–H_2O–NaCl system in which CO_2 solubility in aqueous solutions is determined from the balance between its chemical potential in the liquid phase CO_2 and that in the gas phase CO_2 where the chemical potential of CO_2 in the vapor phase is calculated using the equation of state from Duan, and the chemical potential of CO_2 in the liquid phase is described by the specific interaction model of Pitzer, the deviation of the prediction from Takenouchi & Kennedy[14] withinin 7%.

Portier & Rochelle[16] also presented model for predicting CO_2 solubility in NaCl aqueous solutions based on the balance between its fugacity in vapor and liquid phase CO_2 when reaching phase equilibrium. It found that the prediction is accordance with the model proposed by Duan[27] and data reported in Takenouchi & Kennedy[14].

3.2.3 Molecular Simulation

The dissolution of CO_2 in aqueous solution is explained from microscopic molecular dynamics view recently. SAFT became one hot topic for its validity and well prediction than empirical model. But the compositions is complicated in practical formation reservoir which also include potassium, calcium, magnesium, sulfate, carbonate and so on, so we should extend the model research of CO_2 brine system with taking into the interaction among salt, water and CO_2 molecular.

4 Conclusion

This paper summarized the basic physical properties such as density and solubility of CO_2 brine system so far. The solutions we researched were brine with different concentration or synthetic seawater which different from brine in practical formation reservoir, could not satisfy the requirement of CO_2 sequestration. Most of models were regressed from experimental data, provided with poor ability and validity for

prediction. So a systematic experimental data and a theoretical model with wide applicable range and high prediction accuracy are the basis of the sequestration of CO_2.

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Table 1. Study status on density of CO_2 brine

Researchers	Temperature/℃	Pressure/MPa	CO_2 concentration	compositions
Song[2]	30-50	10-20	wt.(CO_2)%=1–4	Underground water solution
Li[7]	59	0.3-29	c(CO_2)=0–0.958×10^{-3}mol·cm^{-3}	Weyburn underground water Wt.（NaCl）%=8.36
Song[8]	3-10	4-12	wt.(CO_2)%=0–7.7	synthetic seawater（salinity=3.5%）
Nighswander[6]	80-200.5	2.11–10.03	x(CO_2)%=0.28–1.54	Wt.（NaCl）%=1.0
Schmidt [5]	350	400	x(CO_2)%=5 (relative to wate)	Wt.（NaCl）%=40（relative to water）
Teng & Yamasaki[9]	4.85-19.85	6.44-29.49	x(CO_2)%=1.96–3.27	synthetic seawater（NaCl）=0.99–4.99
Gehrig[4]	134.85-373.85	3-281.2	x(CO_2)%=0.18-84.9	Salinity= 6%-20%（relative to water）
Krüger & Diamond	267-374	65-350	x(CO_2)%=9.69	x（NaCl）%=1.74

Wt= mass, x=mole fraction, c=concentration.

Simulated Calculation of Well Killing by Partition Method

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Abstract. The partition method is a new technique which is fit for offshore drilling and deep wells with long bare hole on land. Based on the well control characteristics of deep well, multi-phase flowing control equations of well killing process for partition method are established and numerical calculation is given. The simulation results show that when a great amount of formation gas enters the well bore and traditional well control methods cannot be used, partition method can be used to lead to a successful well killing. The more partitions it was divided into, the smaller change of pressure at casing shoe and choke pressure will be. This condition is easy to control the choke valves. But more partitions also result in a long period of well killing. So reasonable partitions should be determined to ensure safe well killing and save time.

Keywords: Partition method, Well killing, Well control, Gas cutting, Numerical simulation.

1 Introduction

Owing to personal misoperation or equipment failure, formation gas enormously enters the wellbore in drilling. Under the circumstance, unconventional well control method cannot be used to kill the well without causing safety issues[1,2]. The partition method is represented to solve this problem which divides the gas cutting mud into several slugs. And the drilling mud is used to circulate a slug each time from top to bottom. The last slug can be circulated by driller's method or engineer's method[3-5]. By applying this technique, a secondary well kick caused by formation fracture at casing shoe or insufficiency of wellhead choke pressure can be avoided. During well killing, the gas cutting mud can be circulated out of the well for two times or more. Each time the top gas cutting slug is circulated out and is allowed to expand. The conventional well control methods can be used when the last volume of slug is small enough, or the partition method is used to circulate the gas out for times.

There are two available approaches to realize the division of the gas cutting mud:

(1) The drilling pipe can be perforated at the calculated depth of the well. And the bit nozzles are then plugged intentionally until the first circulation is finished. After that the second partition is circulated.(Please see Fig. 1-a) ;

(2) The drilling pipe is pulled for a certain depth and the bit is off bottom. The first partition is circulated. And then trip in and the bit is put down for a calculated depth. The second partition is circulated out. The process is continued until the bit is on bottom and the rest of the kick is circulated out. (Please see Fig. 1-b).

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When a great amount of gas enters the wellbore and conventional well control methods cannot be used, the partition method can lead to a successful well killing without fracturing the formation. During the killing process, the change wellhead choke pressure is relatively small which is easy for us to adjust the choke valve. This new technique is particularly applicable to a deep well drilling with long bare hole on land and offshore drilling with a narrow pressure window between formation pressure and fracture pressure.

2 The Model of Annular Multi-phase Flow

Wellbore annular flow is a complicated multi-phase flow involved with drilling mud phase, natural gas phase and cutting phase[6]. Taking into account both the gas slippage effect in liquid phase and compressibility factor of natural gas varying with temperature and pressure, the calculation is performed. Then control equation and temperature field equation of annular multi-phase flow are established. Combined with initial condition and boundary condition of well killing, the equations are solved by numerical method and the pressure distribution in wellbore is obtained.

2.1 Control Equations of Wellbore Multi-Phase Flow

Continuity equation

Gas phase：

$$\frac{\partial(A_a E_g \rho_g)}{\partial t} + \frac{\partial}{\partial s}(A_a E_g \rho_g u_g + R_g \frac{A_a \rho_{gs} E_m u_m}{B_w}) = 0 \tag{1}$$

Mud phase：

$$\frac{\partial(A_a E_m \rho_m)}{\partial t} + \frac{\partial}{\partial s}(A_a E_m \rho_m u_m - R_g \frac{A_a \rho_{gs} E_m u_m}{B_w}) = 0 \tag{2}$$

Cutting phase：

$$\frac{\partial(A_a E_c \rho_c)}{\partial t} + \frac{\partial(A_a E_c \rho_c u_c)}{\partial s} = 0 \tag{3}$$

Momentum equation

$$\begin{aligned} &\frac{d}{dt}(A_a E_g \rho_g u_g + A_a E_m \rho_m u_m + A_a E_c \rho_c u_c) + \frac{d}{ds}(A_a E_g \rho_g u_g^2 + A_a E_m \rho_m u_m^2 + A_a E_c \rho_c u_c^2) + \\ &A_a g \cos\theta(E_g \rho_g + E_m \rho_m + E_c \rho_c) + A_a g \cos\theta(E_g \rho_g + E_m \rho_m + E_c \rho_c) + \frac{d(pA_a)}{ds} + \left|\frac{dp}{ds}\right|_{fr} A_a = 0 \end{aligned} \tag{4}$$

2.2 Temperature Field Equations

The wellbore and drilling circulating system are regarded as a thermodynamic system herein. According to the principle of conservation of energy, the temperature field equations in wellbore are as follows[7,8].

Temperature field equation in drilling pipe

$$A_p \rho_m v_p c_m \frac{\partial T_p}{\partial s} + m_p c_m \frac{\partial T_p}{\partial t} - 2\pi r_p \frac{U_p}{A_a}\left(T_a - T_p\right) = 0 \tag{4}$$

Temperature field equation in annular

$$A_p \rho_m v_a c_m \frac{\partial T_a}{\partial s} - m_a c_m \frac{\partial T_a}{\partial t} - 2\pi r_a \frac{U_a}{A_a}\left(T_e - T_a\right) + 2\pi r_p \frac{U_a}{A_a}\left(T_a - T_p\right) = 0 \tag{5}$$

Temperature field equation between annular and formation

$$U_a (T_e - T_a) - K_e \frac{\partial T_a}{\partial r}\Big|_{r=r_a} = 0 \tag{6}$$

2.3 Definite Condition

Definite conditions of well killing mainly includes pressure boundary bottom hole and wellbore temperature field boundary[9]. The principle of well killing is to keep the bottom hole pressure constant during the whole process of killing. So the definite conditions are as follows:

$$P_b(t,0) = P_f + P_e \tag{7}$$

$$T(t,i) = f_T(t,i) \tag{8}$$

Where A_a = Annular section area, m^2
E_g = Gas fraction in annular section area, %
E_m = Mud fraction in annular section area, %
E_c = Cutting fraction in annular section area, %
ρ_g = Gas density, Kg/m^3
ρ_m = Mud density, Kg/m^3
ρ_c = Cutting density, Kg/m^3
υ_g = Gas velocity in annular, m/s
υ_m = Mud velocity in annular, m/s
υ_c = Cutting velocity in annular, m/s
υ_a = Mud velocity in drilling pipe, m/s
s = Coordinate of multi-phase flow direction, m
f_r = Frictional loss along the annular, Pa

P = Pressure at wellbore, Pa
θ = Hole deviation angle, (°)
A_p = Section area of drilling pipe inside, m^2
T_a = Temperature in annular, K
T_p = Temperature in drilling pipe, K
T_e = Formation temperature, K
m_a = Mass flow of annular mud, Kg/s
c_m = Specific heat capacity, J/(Kg·K)
U_a = Overall heat transfer coefficient in annular, W/(m^2·K)
K_e = Formation thermal conductivity coefficient, W/(m·K)
r_p = Radius of drilling pipe, m
r_a = Radius of annular area, m
r = Distance between annular point and annular center of circle, m
P_b = Bottom hole pressure while well killing, MPa
P_f = Formation pressure, MPa
P_e = Safety margin while well killing, MPa
T = Temperature in wellbore, K
i = Computing node point
f_T = Wellbore temperature field function of time and computing node point

3 An Example and Result Analysis

Information of a vertical well is used herein. The well depth is 4325m. The plastic viscosity of drilling fluid is 0.03Pa·s, the yield value is 10.22Pa and the density is 1590 Kg/m^3. The volume rate of the drilling fluid is 0.02m^3/s. The casing program is as follows: the Φ244mm casing is used from 0m to the depth of 2058m; the wellbore is uncased from 2058m to 4325m. The size of drilling strings is 127mm in diameter along the whole borehole. The borehole diameter is 244.4mm in diameter from 0m to 2058m and is 220.32mm in diameter from 2058m to 4325m. The reservoir pressure was 69.2MPa. The formation fracture pressure gradient is 0.0187MPa/m. The geothermal gradient is 3°C/100m. The bearing resistance of wellhead equipment is 105MPa. The gas kick volume is 2m^3 when well killing starts.

3.1 The Maximum Pressure at Casing Shoe with Different Gas Kick

Fig. 2 shows the relation curve between the maximum pressure and the initial gas cutting at the casing shoe. From Fig. 2, when the initial gas cutting volume increases, the maximum pressure at casing shoe in well control increases. If the casing depth is 2058m and the initial gas cutting volume is 1.3m^3 , the maximum pressure produced at casing shoe in well control has been higher than the fracture pressure at the formation here (Shown at point A); If casing depth is 2500m and the initial gas cutting volume is 2.55m^3, the maximum pressure at the casing shoe has reached the fracture pressure at the formation here (shown at point B); If casing depth is 2500m and the initial gas cutting volume is 4.96m^3, the maximum pressure at casing shoe has reached the fracture pressure here at the formation (shown at point C). When killing the well with traditional methods, the deeper of the casing, the smaller of the allowed

gas cutting volume. If surpassing the value, it will not be able to completely killing the well.

3.2 Casing Pressure during Partition Method Killing

If the casing depth is 2058m, each time we can circulate at most 1.3m^3 volume gas. When the well is invaded 2m^3 gas, the gas will be respectively circulated out of the well with two or three times.

From Fig. 3, starting from point O to point A, it will circulate the above gas cutting slug out of the well-head with the original drilling mud. From point A, we use driller's method to make the surplus gas circulate out of the wellhead and kill the well with kill mud. OA and OB section are respectively the process of circulating the two slugs out of the well. The time used by OA section is shorter and the maximum casing pressure is lower than AB section because the gas of AB section is at the bottom of the first slug and needs more time to be circulated out of the well. The gas pressure at the bottom is higher than that of the above, therefore, the maximum casing pressure is higher than the first partition.

Fig. 4 is the process of killing the well with three-partition method. The killing process of Fig. 4 is basically the same with Fig. 3, however, the maximum choke pressure of the wellhead is lower than that of Fig. 3 in the process of killing the well and the pressure at the casing shoe will decrease. Because the more the partitions are divided into, the less gas is circulated out of the well each time, and the choke pressure produced by gas rising is lower, but the period of killing a well is correspondingly longer.

3.3 Pressure at Casing Shoe during Patition Method Killing

Fig. 5 and Fig. 6 are respectively the pressure's variation with time at the casing shoe using two-partition method and three-partition method to complete killing the well, and the fracture pressure of the formation at the casing shoe is 38.4MPa.

From Fig. 5, the maximum pressure at the casing shoe is point C and after point C the pressure decreases rapidly because point C is corresponding to the time the main part of gas reaching the casing shoe. Afterwards, gas cutting mud gets through the casing shoe in a quite short time resulting in pressure's rapid decrease at the casing shoe; DE section is the process of the second gas cutting mud circulated from the bottom of the well out of the casing shoe. At FG section, the pressure at the casing shoe continuously decreases and finally becomes stable because starting from point F, kill mud reaches the position of the bit and the original mud is continuously replaced by kill mud. Point G is corresponding to the time of kill mud reaching the casing shoe. After the kill mud getting through the casing shoe, the pressure at the casing shoe keeps unchanged till the end of well killing. After the end of well killing, the pressure at the casing shoe keeps at the hydrostatic column's pressure of kill mud constantly.

Fig. 6 is the process of killing the well with three-partition method. From the figure, in the process of well killing, the maximum pressure at the casing shoe is smaller than that of two-partition method. The maximum pressure at the casing shoe is as follow: the third circulation < the second circulation < the first circulation. Because after circulating a gas cutting mud slug, the wellhead choke pressure will decrease, so the

pressure at the casing shoe also reduces. The more partitions we divide the well killing into, the safer the casing shoe in the process of well killing will be, but the relevant killing period is longer. The pressure at the casing shoe after completing killing the well with three-partition method is the same as that of two-partition method.

4 Conclusions and Advice

- In theory, any volume of gas kick can be circulated out of the well in one partition or more without causing the formation fracture. Then a balance of pressure in the wellbore can be resumed.
- The partition method is applicable to killing a deep well with long bare hole when a large volume of gas kick occurs. It is also applicable to offshore drilling in that the pressure window between formation pressure and formation fracture pressure is narrow.
- For a certain volume of gas kick, the more partitions you divided the kick into, the lower the wellhead choke pressure will be, which is easy for us to control the choke valve. More partitions also decrease the pressure at the casing shoe. But the well killing time is correspondingly long.
- After the times of partition is determined, the perforating depth or off-bottom depth need to be accurately calculated in order to shorten the well killing time and ensure the safety of the formation.

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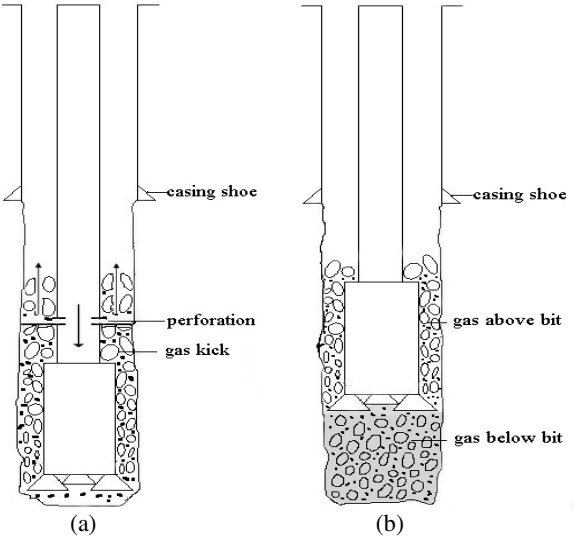

Fig. 1. Two approaches to realize partition: (a) perforation at certain depth, (b) put the bit off bottom

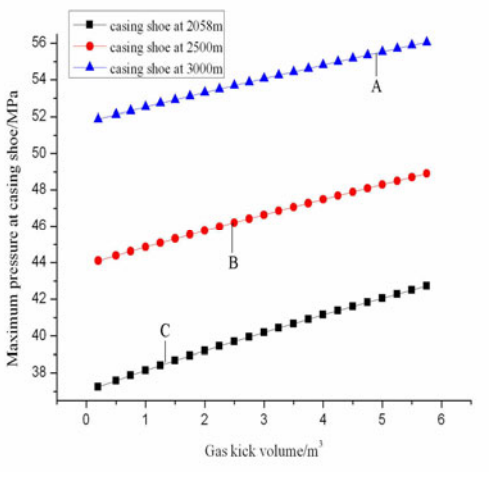

Fig. 2. The maximum pressure at casing shoe at different gas cutting

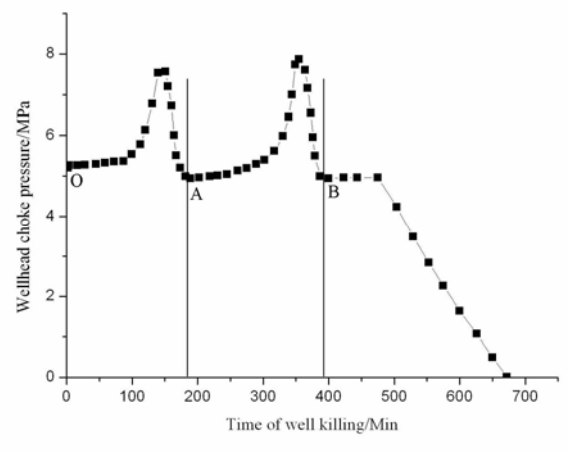

Fig. 3. Choke pressure during two-partition method

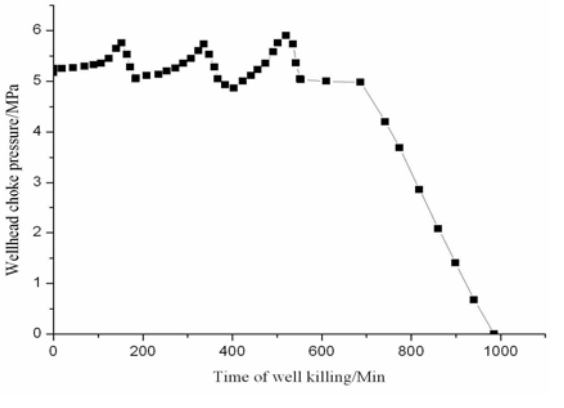

Fig. 4. Choke pressure during three-partition method

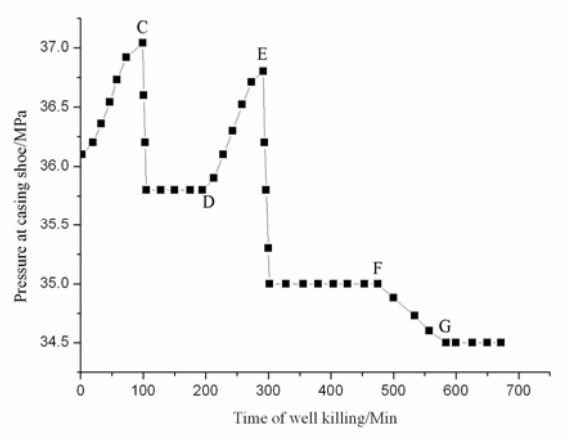

Fig. 5. Pressure at casing shoe during two-partition method

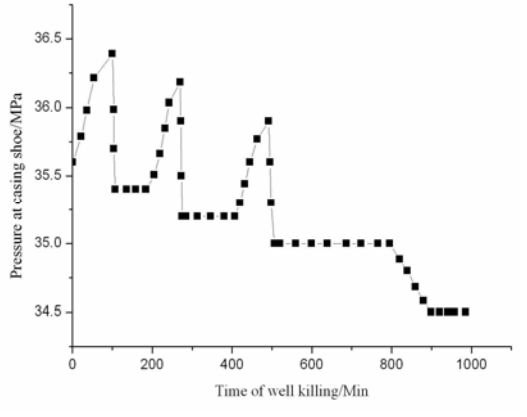

Fig. 6. Pressure at casing shoe during three-partition method

Tectonic Analysis of Wenchuan Earthquake Collapse and Landslide Development Characteristics and Spatial Distribution Law*

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Abstract. Collapses and landslides induced by Wenchuan earthquake concentrated in the hanging wall of causative fault, and high-density areas mainly located in the 30km radius buffer zone of the causative fault (Yingxiu - Beichuan fault). And its' mechanism and characteristics showed collapses bodies launched, landslides bodies long-distance and throwing slided which were different from normal gravity slumps. This paper analysises the development characteristics and spatial distribution of earthquake collapses and landslides from the deep structure and its shallow surface response by geological survey and interpretation of the geophysical data and remote sensing data. The research suggests that many phenomena and problems related to the Wenchuan earthquake collapses and landslides are far beyond people's previous cognition, and its development and distribution characteristics are closely related to lower crust flow of the Qinghai-Tibet plateau and the conversion between its horizontal and vertical movement, hence the mechanism of the earthquake is the key issue of earthquake collapse and landslide development.

Keywords: Wenchuan earthquake, collapses and landslides, lower crustal flow, mechanism of the earthquake, tectonic analysis.

1 Introduction

Ms8.0 earthquake occurred in Wenchuan County, Sichuan Province, on May 12, and its epicenter was located southwest of the town of Yingxiu, focal depth of 14km. Wenchuan earthquake is the most large disaster since the founding of New China, spreading to the maximum extent, inducing the most severe secondary geological disasters. Geological survey found that the earthquake caused 240km and 90km fracture zone respectively along the Yingxiu-Beichuan fault and the Pengguan-Anxian fault, with 6.8m maximum vertical displacement and 4.8m horizontal displacement[1, 2]. Collapse and Landslide disasters not only were the most common phenomenon, but also caused the most serious damage[3].

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Earthquake collapses and landslides are significantly different from common ones on the geometry, slump surface integrity is poor, and shear opening shows distinctive features with "sharp point protruding" or "protruding edge", reflecting the upper sliding body is disintegrated by seismic force, even impacts with the lower margin after throwing[3]. These landslides and collapses were controlled by strong earthquake, and slipping mechanism and characteristics were different from the common gravity ones, showing collapses bodies launched, landslides bodies long-distance and throwing slided which were different from normal gravity slump. Meanwhile, the development degree of slumps located on both sides of the fault exsited differences, and most of sumps located in the hanging wall of causative faults, no more than 10% developping in the footwall, and high density areas are located in 30km radius buffer of Yingxiu-Beichuan fault. All of these are far beyond people's accepted cognition, but statistical results reveal the spatial distribution of the slump disaster has its particularity.

This paper analysises the earthquake collapses and landslides development characteristics and spatial distribution law focusing on the deep structure and shallow surface responsement, based on the post-earthquake geological survey and remote sensing interpretation, using GIS spatial analysis methods, referring to the regional geophysical data, continental dynamics as a guide, the genetic model of the earthquake based on lower crustal flowing theory as the starting point, and then reveals its close contact with plateau lower crust horizontal movement and vertical movement. Tracing the origin, these studies will lay the foundation for the research of prediction and prevention of strong earthquake collapses and landslides.

2 Geological Background

A. Faults system

Earthquake epicenter located in the tectonical border between the Longmen Shan orogenic belt and Sichuan basin. Longmen Shan belt is typical of tectonic geomorphology crustal thickness and gravity gradient in Chinese continent, composed of four near-parallel NE - SW faults[5], west from the western edge of Sichuan basin, followed by Dayi - Guangyuan fault, Pengguan - Anxian fault, Yingxiu - Beichuan fault and Wenchuan - Maowen fault.

Dayi - Guangyuan fault is a buried fault; Pengguan - Anxian fault section appears as imbricated mix, NE-SW direction, developed in part of the Paleozoic and Mesozoic strata, the total length of about 130km, mainly brittle deformation of the thrust, and it is one of seismogenic fault; Yingxiu - Beichuan fault is one of the the main earthquake seismogenic faults, composed of a series of small imbricate thrust belt, nearly parallel to the Peng - Anxian fault, a total length of 514km, metamorphic rocks in the north-west wall thrusting above the Paleozoic and Mesozoic sedimentary rocks, and the nature shows thrusting and right-lateral strike-slip. Wenchuan - Maowen fault is the back boundary of Longmen Shan tectonics belt, and Xu et al (2007) proposed a large toughness detachment fault developping on the western edge of Longmenshan - Jinping - Wenchuan, Ya An, west Kangding and west Mianning[6], and field investigation found that Wenchuan - Maowen fault developped over 500m wide ductile shear zone, and the footwall mylonite sheared strength, rock stretching lineations were well

developed, therefore it is inferred that it is a detachment fault between the metamorphic rocks (Pengguan complex rock) in the walls of Wenchuan – Maowen fault and the western cover, with extrusion tectonics and extensional tectonics occurring conversion.

B. Layered rheology of crust

Geological and geophysical data show that, the Tibetan Plateau's eastern margin crust's tectonic is quitely complicated, with layered rheology. The crust hierarchical structure can be well reflected by seismic velocity and electrical structure, as early as 1989, Liu Jianhua studied on the crust and upper mantle's 3D velocity structure of Chinese north-south belt by seismic tomography method, and the imaging results showed that significant lateral heterogeneity existed between north-south belt of the crust and upper mantle, and the low velocity layer existed in a large range of middle-lower crust [7]; Wang Chunyong, according to the P wave and S wave data of 4625 region when first-break recorded by 174 earthquake stations of Nanhe, combining with other deep geophysical data, and researching on the crustal and upper mantle's 3D velocity structure in Sichuan Yunnan area, it showed that, high conductivity layer existed in the excessive band between the crust and upper mantle, and he presumed a series of listric fault of westward tilt appeared below Kangding to Luding, and they extended upwardly and connected with the upper crust brittle fault, and downwardly disappeared in the middle and lower crust, in another, he inversed the crust and upper mantle's velocity structure of S wave in the Tibetan Plateau and adjacent areas, taking advantage of the information of broadband seismic stations in the western region of China, and on the Rayleigh wave group's velocity distribution diagram whose cycle was 2912s and 4219s, it showed that a large range of low velocity anomaly existed in the eastern Qinghai-Tibet Plateau (including the Western Sichuan Plateau) , and it provided internal evidence for the lower crustal flow model [8, 9, 10]; Ma et al pointed that the high conductivity layer existed universally in the middle -lower crust of northeastern region in Tibetan Plateau, and they insisted that its origin may be partial melting[11]; Sun Jie found a few tens of kilometers of lateral rheological material trace in the deep of the eastern margin of the Tibetan Plateau by detecting the electricity structure on the crust and upper mantle[12]; Recently, Bai Denghai inversed the crust deformation characteristics of the eastern Tibetan Plateau using magnetotelluric method, and found two high conductance channels existed in nearby 20-40km, which extended levelly more than 800km from the central Tibetan Plateau to southwest China [13].

Crust with low velocity and low resistance layer may reflect that, the crustal material performs low viscosity and ductile deformation characteristics, and earthquake is closely related to low velocity and resistance layer.

3 Development Characteristics and Spatial Distribution Law of Collapse and Landslide Caused by Wenchuan Earthquake

A. Development characteristics of collapse and landslide caused by Wenchuan earthquake

According to the survey, the speciality of development characteristics of collapse and landslide caused by Wenchuan earthquake displays in three aspects, which is the long

distance launched of collapse body, the high potential energy's slip of landslide body and the throwing and slip of landslide body.

1) Be different with common gravitational collapse, the collapse caused by heavy earthquake displayed as long horizontal launched distance of the collapse body, and it accumulated on the gentle area nearby the toe of slope without significant packing characteristics (Fig.1a).
2) The high potential energy's slip was developed in the deep-cutting river valley of high surface waviness, and the landslide body slip with fast speed under the earthquake force. The whole feathers were displayed as: steep slip surface, shorter horizontal scanning and longer vertical one (Fig.1b).
3) The throwing and slip landslide was the typical type under the heavy earthquake which was distinct from common gravitational landslide, and it showed in the following: slip surface was not typical, and always displayed as untemper, loosening, intermittent and showed the whole pull apart and deviation; landslide body integrity is not good and it's original structure was destroyed heavily, or accumulated as loosening soil and crushed stone; the salient bank slope had significant bruise and scraped marks caused by the landslide body[4]; the bottom slip surface was smoothly with lower than 10°(Fig. 1c, 1d).

Fig. 1. The type of development characteristics of collapse and landslide caused by Wenchuan earthquake

a. the long distance launched of collapse body in Xuankou town; b. the trailing edge and posterior wall of wangjiayan landslide in Beichuan; c. unsmooth surface of jingo landslide's posterior wall in Chenjiaba; d. obvious demarcation of cuijiayoufang landslide's long distance throwing and slip in Chenjiaba

B. Spatial distribution law of collapse and landslide caused by Wenchuan earthquake

Based on the remote sensing interpretation and geological survey to the earthquake geology disaster of collapse and landslide, combined with the existing seismic collapse and landslide data, the heavy disaster area of landslide data results showed that the collapse and landslide caused by Wenchuan earthquake had the following characteristicses on spatial distribution.

1) Earthquake collapse and landslide distributed along seismogenic faults in NE-SW (width of about 70km), the nearer to earthquake faults, the more intensive of the disaster, and the dense area located in 30km radius buffer of seismogenic fault (Yingxiu fault – Beichuan fault) (Fig.2).
2) The development degree of the earthquake collapse and landslide existed differences between eastern and western taking seismogenic fault for boundary, most of which are distributed in the the hanging wall of seismogenic fault, and only no more than 10% developed in the footwall; In order to study landslip uneven spatial distribution characteristics more specifically, this paper adopts 1 square kilometer grid to statistic landslide volume for each square kilometer range, and the data display that disaster, high density area focused on basin-mountain boundary fault's plate (Fig. 3).

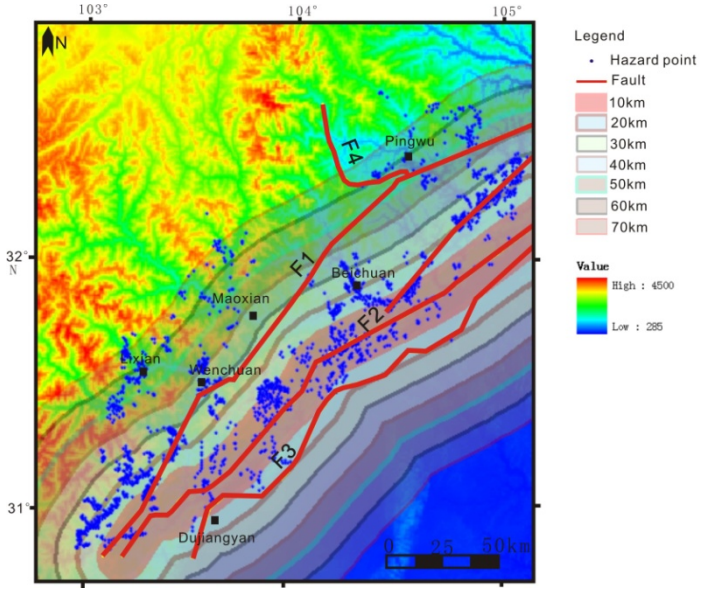

Fig. 2. The distribution graph of the earthquake collapse, landslide along the main faults in different radius buffer (data source from the national Wenchuan earthquake expert committee in 2008 June Wenchuan earthquake atlas of geologic hazards

F1. Wenchuan - Mao Wen fault; F2 Yingxiu - Beichuan fault;
F3. Peng Guan-An xian fault; F4.Huya fault

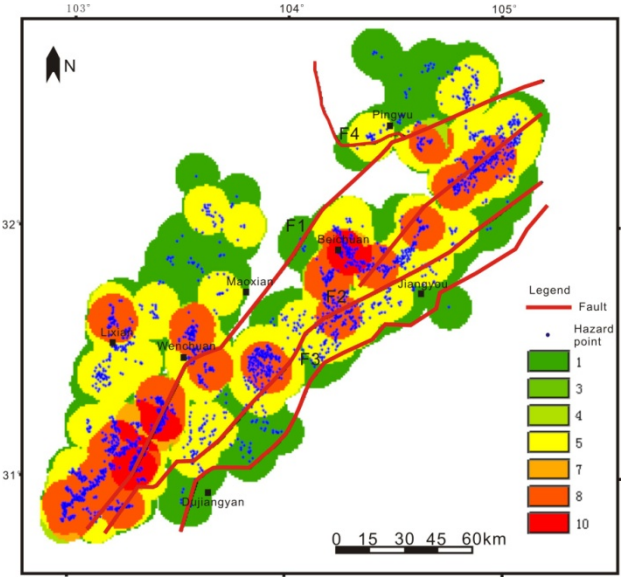

Fig. 3. The density map of the earthquake landslide and landslide distribution (the number of disaster points in the range of 1km^2)

F1. Wenchuan - Maowen fault; F2 Yingxiu - Beichuan fault;
F3. Pengguan-Anxian fault; F4.Huya fault

4 The Analysis of Formation

A. Genetic mechanism of the earthquake

Wenchuan earthquake epicenter located in Longmen Shan tectonical belt whose distance is all more than 2000km from the West Pacific plate boundary and North India Ocean plate boundary, the two plate boundary didn't occur synchronously when Wenchuan earthquake occurred,and the plate interior occurred remotely rupture but the subducting plate boundary didn't not have any response [14]; and then with multiple stages of tectonic evolution of Longmen Shan structural belts, the closest to the Wenchuan earthquake zone plate boundary is the Ganzi-Litang suture zone, and the plate collision energy has been depleted 2Ga ago. So the plate theory can not explain the cause of Wenchuan earthquake, we must introduce the theory of continental dynamics and establish mechanism of intraplate earthquake model.

Maggi et al found that continental earthquake source focused on the range of 10-40km depth, Ma Zongjin named the source advantage layer as " the seismogenic layer", Luo Wenxing statistic the distribution regularities of Qinghai-Tibet Plateau's intraplate earthquake sources and found no earthquake in the lower crust, focal depth was more concentrated in the earth's crust, and the Wenchuan earthquake focal depth is 14km, it is located in the the brittle ductile transition's middle crust of Longmen Shan structural belt, so the earthquake mechanism is closely related with the crustal layers.

The geological and geophysical survey showed, the continental lithosphere had the characteristics of layered rheological and controlled the continental intraplate earthquake activity. Wenchuan earthquake region's layered rheology was discussed above, and not the" rigid ", low velocity and low resistance melting weak layer existed under the crust. Li Dewei pointed that seismogenic mechanism was lower crustal flow and middle crustal ductile-brittle shear, in particular to crustal heat flow material of Ganges River basin flowed into the Tibetan Plateau, with the block of Tarim consolidation crustal, the marked thickening of the lower crust in the plateau abdomen flowed towards the east, eastern Tibetan plateau's lower crust of Yanshan period in newborn was again displaced by the ductile lower crust since the Miocene, when the crust ductile - brittle transition zone of strain energy accumulated to the upper crust brittle limit caused by the ductile lower crust flow , the upper crust ruptured and then Wenchuan earthquake occurred [15, 16, 17, 18]. The Wenchuan earthquake genetic model has the universality of explaining intraplate earthquake genesis.

B. Tectonic analysis of collapse and landslide development characteristics and spatial distribution

Development characteristics and spatial distribution exist many differences between Wenchuan earthquake-induced and common slumps[19,20,21]. Many scholars studied this issue from more of earthquake faults control, topography, lithology, rock occurrence constraints and other areas, yet stayed in the shallow crustal levels. Author thinks systematic study should be carried out from the deep crust tectonic controlling shallow structure, morphotectonic evolution in basin-mountain coupling process, relationship between multi-stage faulting and paleoseismic and paleo-landslide, and then we can fundamentally find the development characteristics and formation mechanism of Wenchuan earthquake-induced collapses and landslides.

Hereby, author analysises the developmental characteristics and spatial distribution law of Wenchuan earthquake slumps using the genetic model of intraplate earthquakes based on continental lower crust flowing theory created by continental dynamics, perspective from the deep structure and the surface response. It exists coupling relationship between the flowing of lower crust from Qinghai-Tibet Plateau to the Sichuan Basin and the upper crustal block movement and deformation, and horizontal movement of brittle upper crust is driven by crust lower crustal flow[22,23,24]. The flow direction of the lower crust is consistent with the direction measurement of surface movement depending on GPS[25]. Therefore, the hanging wall of the seismogenic fault, as the direct dragged plate by the lower crust, should be the active plate because of energy earthquake release, so earthquake-induced slumps high-density areas should be concentrated in the active plate. More importantly, the seismogenic faults thrusted caused by the the upward movement of the thickened lower crust blocked by the Sichuan Basin consolidated basement which flowing from the Tibetan Plateau, which caused many large-scale long-distance and throwing slided slump bodies developping. The dense area of landslide disaster caused by Wenchuan earthquake almost located in the 30km radius buffer of seismogenic fault (Yingxiu-Beichuan fault), as for this phenomenon, it could be explained that part of the lower crust flow material refluxed and upwelled to the area below the seismogenic fault after being blocked by the Sichuan basin's consolidating substrate material, and then formed eddy current which produced centralized releasing energy, and in this eddy zone, the trend from south to

north were controlled by the western margin boundary of Sichuan basin, and the radius of east-west direction were restricted by the momentum and impulse of the lower crust flow material.

5 Conclusion

A. Development characteristics and spatial distribution law of collapse and landslide caused by Wenchuan earthquake

Unlike the common gravitational collapse, with the speciality of heavy earthquake slump, the development characteristics of collapse and landslide caused by Wenchuan earthquake displayed in three aspects, which was the long distance launched of collapse body, the high potential energy's slip of landslide body and the throwing and slip of landslide body. The spatial distribution of the collapses and landslides had their regularity, and the whole landslide body caused by Wenchuan earthquake distributed in NNE direction along the seismogenic faults which is basin-mountain boundary, the secondary geological disaster's growth rate of the hanging wall's was significantly higher than that of the footwall in the main seismogenic fault (Yingxiu-Beichuan fault), and the dense areas almostly located in the buffer of 30km radius.

B. The analysis of genesis

Blocked by the Sichuan basin's consolidating substrate material, the lower crustal flow material from the Tibetan Plateau's abdomen to Longmen mountain got thicker, accompanying by it's upwelling diapirs, and then caused the main seismogenic fault plate's thrusting, as a result of the upper plate's big active thrusting energy of high angle, which was beyond the gravity of landslide body, so many large remote collapse bodies, high potential energy landslide and high speed throwing landslide with long distance formatted. At the same time, lower crustal flow material impacted the Sichuan basin of consolidating substrate material, according to the law of conservation of momentum, part of the lower crust material of basin-mountain shunted to south and north along the Sichuan Basin and the Longmen Shan tectonic belt boundary, part refluxed from east to west, and eddy zone appeared near the western of the basin-mountain boundary, under the additional action of the region's diapiric upwelling by the thickened lower crust, energy concentrated release area was produced, the north-south trend paralleled to the basin-mountain boundary in this region, which controlled the distribution characteristics of Wenchuan earthquake collapse and landslide disaster, and the spacing from east to west were approximately equal to the radius of collapse area of high density buffer in Wenchuan earthquake (about 30km).

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Finding a Safety Distance for Vehicles for the ACC System through Simulation

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Abstract. Rapid development in computing is enabling a benchmark for the possibility of more accurate and extensive simulations of various processes through specialized programs. The automotive industry is providing technical equipment support in which simulations are widely applied. The purpose of this article is to establish a safety distance between vehicles for the ACC system through the simulation of vehicles under different conditions. Vehicle braking distances are obtained from many surfaces. The result of simulation is to establish safe separation of two consecutive vehicles of under the same conditions.

Keywords: safety, braking distance, braking force, adhesion, simulation.

1 Introduction

The European Commission requested a decrease in the number of road fatalities of 50% by 2010 which made a challenge for the automotive industry. Despite the amount of road fatalities in the EU it is still too high. During 1.3 million road accidents 43 000 people died and 1.7 million people were injured. In the field of providing supportive technical devices to vehicles, the present computing power of modern computers allows the simulation of different processes. One of the main parts of their application is to examine, adjust and test various assistance systems such as the ACC, ESP, Pre-Crash Braking-control system and so on. Given that the ACC system contains components which discover an approaching object to the vehicle and its relative speed, a breaking system was added to the ACC to prevent a collision (Pre-crash-Braking Control System) [1]. Both require the correct data for their correct functioning. This data can be defined and then tested in the simulation of the dynamic vehicle model.

For the purpose of these simulations more products are accessible on the market: CarSim, Adams/car or Matlab.

CarSim simulates the dynamic behaviour of racing cars, travelling vehicles, transportation and light commercial vehicles. Software can animate simulated tests and outputs of more than 800 variables [2]. In Matlab/Simulink is used for the simulation of longitudinal movement prepared module "Longitudinal Vehicle Dynamics" which allows one to build their own model and simulate various situations.

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The aim of this article is to propose a simulation model in MATLAB/Simulink for determining a safe separation of two consecutive vehicles under different conditions on the ground. The model can be used by one who has a mathematical background of knowledge and is able to expand in different directions according to requests.

2 Model of the Car

The common basis for all programs / software for simulating characteristics of the vehicle is its mathematical model. It provides feedback on the entries based on changes in its parameters.

The assistance system ACC and the Pre-Crash Braking-control systems which are included in the ACC, which requires a very precise calculation of the safety distance between vehicles for it to function. A comparison is then made with the distance of vehicles while the front vehicle's speed is considered (Fig. 1). The breaking distance of the front vehicle is calculated on the basis of substitution and an estimated maximum deceleration a_{max}. The set recommended values for a_{max} are as follows [3]:

- Dry road surface $a_{max} = 6{,}5\ ms^{-2}$,
- Wet road surface $a_{max} = 6{,}0\ ms^{-2}$,
- Icy road surface $a_{max} = 2{,}5\ ms^{-2}$.

Elaborated studies and articles on the future of communication between vehicles [4] are gradually appearing. Information to be transferred between vehicles would be their maximum stopping distances on different surfaces.

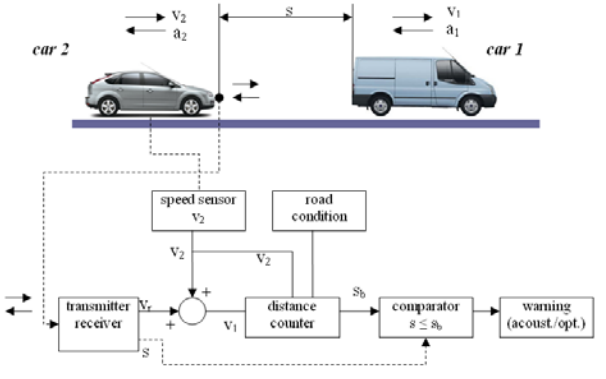


Fig. 1. Principle of solving the safe distance [3]

On the market different software products for simulations can be found, e.g. CarSim, Adams/Car, or Matlab. CarSim can simulate and animate different situations and export data into other software such as MATLAB, Excel, etc.

With mathematical knowledge of the background of simulated events it is possible to use Matlab/Simulink, which provides a graphical user interface for creating mathematical models as block diagrams. This presents an interactive graphical interface and groups of adjustable library blocks, which enables one to model, simulate, implement and test different time-varying systems, including communications, control, signal processing, video and display [5]. For simulation of the longitudinal motion the repaired module called "Longitudinal Vehicle Dynamics" can be used (Fig. 2).

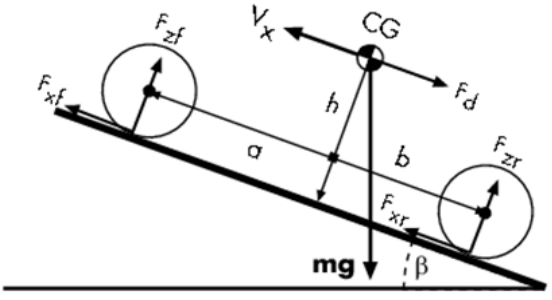


Fig. 2. Longitudinal Vehicle Dynamics [3]

3 Model for Finding a Safe Distance between Vehicles in MATLAB/Simulink

The graphical interface MATLAB/Simulink is popular for creating dynamic models in many fields such as electronics, hydraulics, chemistry and control systems. Matlab is also a widely recognized platform for mathematical models.

A model in MATLAB / Simulink is used to determine a safe distance in the longitudinal movement of vehicles (does not address the effects of lateral forces and directional stability) this is shown in Fig. 3. To simulate a variety of surfaces and transitions between them the model incorporates the following parts:

- Changes to the road surface during braking,
- Change of initial speed of the vehicle at the start of braking,
- Reducing the coefficient of adhesion while increasing speed for different surfaces,
- a possibility to Switch on and off the ABS system,
- ABS controlled by PID controller,
- Consideration of tilt in the longitudinal direction during braking,
- Simulation of changes in the road's gradient,
- Taking into account air resistance,
- Hydraulic brake system delay.

The model incorporates the two curves of the slip coefficient of adhesion, which are switched by the switch module according to the travelled roadway. They are used in the module look up table that calculates the approximation to the function y = f(x).

The total distance travelled is obtained by integrating the vehicle speed vx. Peripheral power from the left and right wheel axles are counted and fed back into the module "Longitudinal Vehicle Dynamics". The simulation is stopped when reaching a speed $v_x = 0$ m/s.

The ABS system can be simulated through a PID controller. A gain value for each component of the PID controller can be obtained in Matlab through "Simulink ® Response Optimization ™". The boundaries of the tuning variables change their values in order for the optimised signal to approach the required level.

With the proposed model it is possible to simulate various situations that have both a positive and negative impact on the safety distance. It is possible due to the possibility of changes of the two surfaces, the length of the second surface section and the change of road inclination. The absence of the ABS system to break at a safe distance from the front the vehicle can be simulated by cancelling feedback from the controller rearrangement wheel.

A typical problem encountered when solving a safe distance between vehicles in situations is demonstrated by Fig.4 To identify the road segment with worse adhesion conditions on the road for a distance of tens of meters is problematic, while in the case on of Fig. 4a this kind of surface before the front vehicle, which further reduces the possibility of detection. The worse case is if the front vehicle braked after the section with worse adhesion conditions (Fig. 4b). This would mean extending the stopping distance only of the rear of the vehicle and the safe distance in the case of Fig. 4 would not have been sufficient. The case in Fig. 4c is equally complicated. A short stretch of road with a sudden descent is difficult to detect and again requires the re-extension of a safe distance.

The necessary changes for the safety distance can be detected by the simulation model shown in Fig. 3. The output of the simulation can be presented graphically and analyzed. Fig. 4 shows traces of braking distances and the coefficient of adhesion to determine the safe separation of two consecutive vehicles. The vehicle in front is starting to decelerate from 80 km/h and the vehicle behind is starting to decelerate from 100 km/h. The graphs show that the vehicle in front has passed through a 10 m long section with adhesion conditions that the rear vehicle experienced earlier. You can also see the sequence of traversing this section by the front and rear axles of the vehicle. By reducing the speed the coefficient of friction increases, which is represented by a gradual reduction in the graph of acceleration (increasing retardation). The calculated value of safe separation can be read from the chart (27 m). Characteristics for the case of Fig. 4b are shown in Fig. 5b. The safety distance of vehicles after moving from the section with reduced adhesion conditions behind the front vehicle which have increased to 33.5 meters, which represents a 24% increase.

When changing the sloped 10 meter section by 9%/5.1˚ (Fig. 4c) the following characteristics were recorded as shown in Fig. 5c. The safety distance of vehicles in this section appeared in the simulation of 30 meters as compared to the 27.8 meter section of road without having a changed slope. In addition to these characteristics it is possible to export from the model other various characteristics such as the load of the front and rear axles (Fig. 6), rearrangements of individual wheels, brake torque, coefficient of adhesion etc.

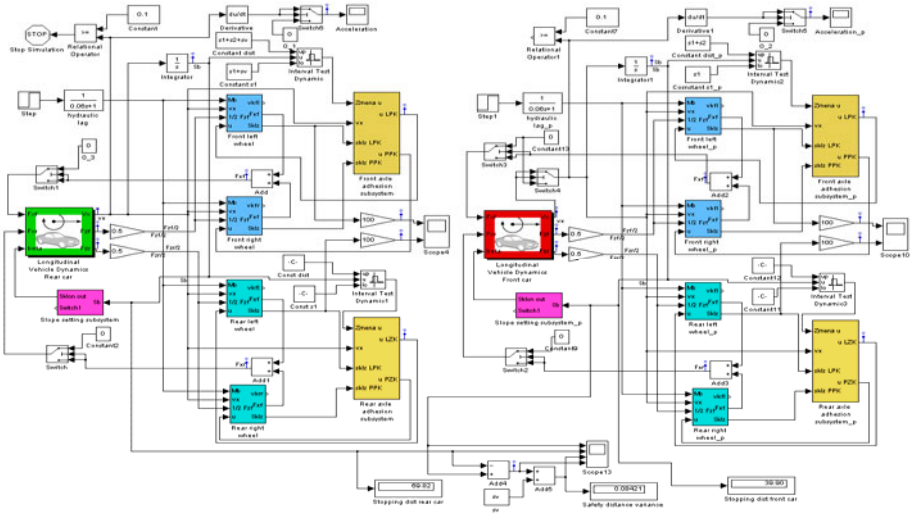


Fig. 3. Model of longditudinal movement of two vehicles for the dicovery of the safety distance

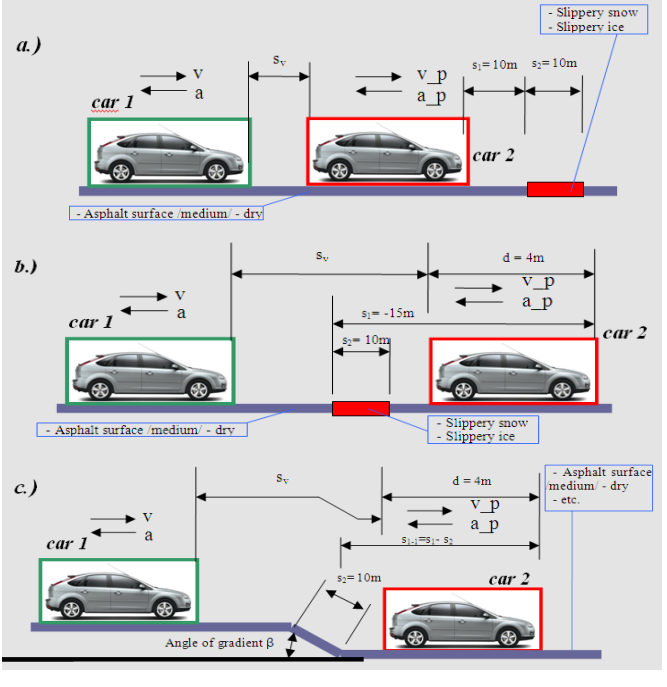
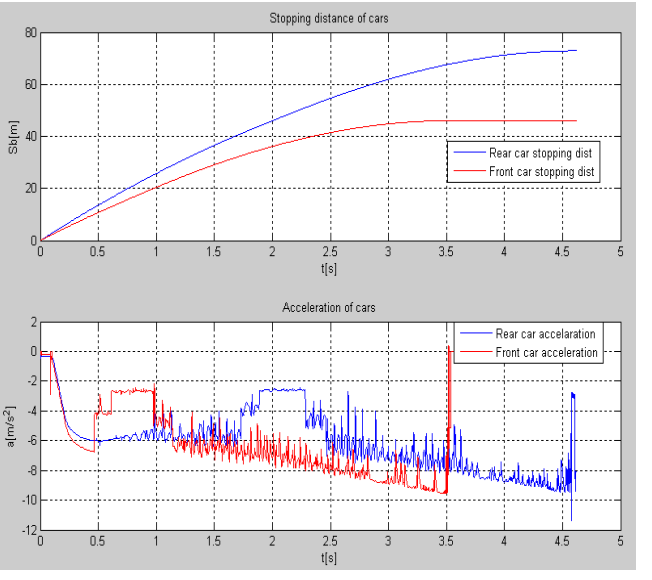
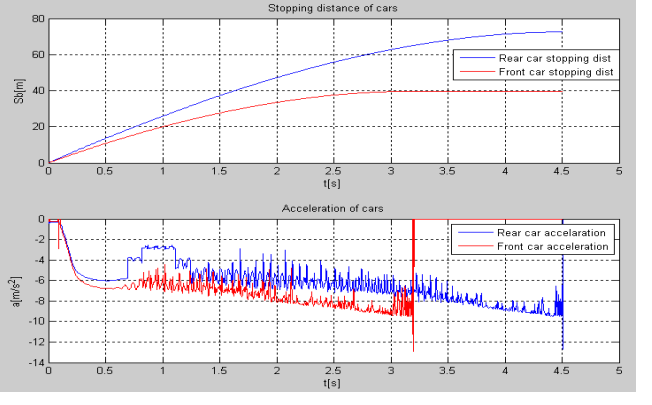


Fig. 4. Situations resolved in defining a safe distance between vehicles

a.)



b.)



c.)

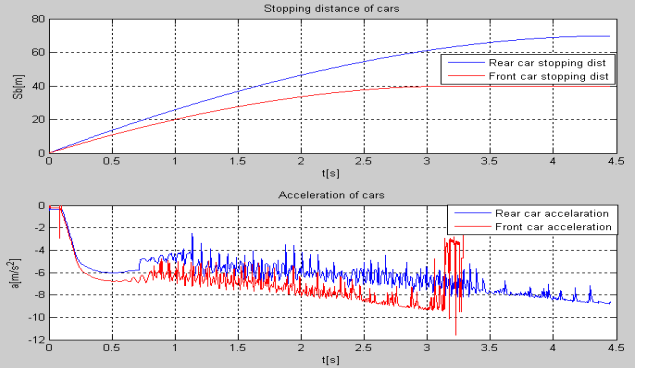


Fig. 5. Traces of acceleration lanes, and vehicles for the situation of Fig.4

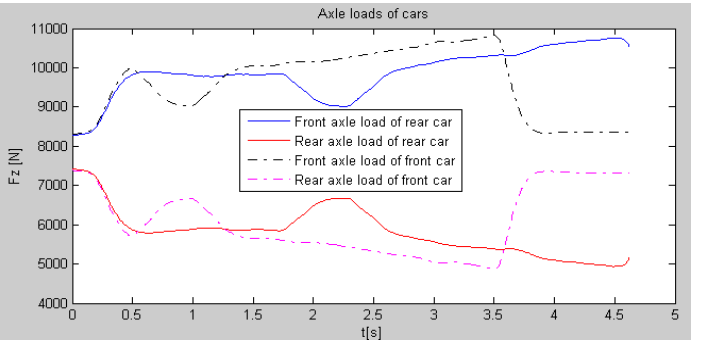


Fig. 6. Traces of axle loads of vehicles

The simulation in this case does not reflect the rolling resistance and hydroplaning. When calculating the coefficient of rolling resistance for cars, we speed up to 80 km/h and this is considered to be independent of the running speed [6]. In the case of hydroplaning the tread depth and the value of the road's water level would have to be inserted into the simulation.

4 The Coefficient of Adhesion

For a proper simulation, it is necessary to know the coefficient of adhesion for different surfaces. It depends on the quality of the tire contact surface and the pad. The method for finding the coefficient is detected by operating the angle of the vehicle's steering wheel, vehicle speed, operating pressure of the hydraulic control unit front wheel and then calculating the coefficient of adhesion of the road surface when turning the vehicle while taking into account the rearrangement of the relationship between angle of the front wheel adhesion coefficient on the road's surface and the lateral guiding force behind the front wheel [7]. Another option is to recognize the surface by reflection of infrared radiation from the road surface. The received signal is compared with a reference signal for dry, wet, snowy and icy conditions [8]. In the simulation one must take into account the reduction coefficient of adhesion with increasing speed [9].

5 Conclusion

Simulation and graphical interface simplifies the analysis of physical phenomena and allows for a relatively easy calculation and optimization of the basic characteristics for the process of changing the system parameters. A mathematical model is the basis of a correct simulation. Another important aspect is the low economic contingence of virtual simulations, while some simulations under normal conditions would probably not be feasible.

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Research on Performance Assessments of University Counselors in Private Colleges

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Abstract. The management capacity of human resources in each college determines the development and competitiveness in the future. University counselor, or can be called instructor, not only is a driving force behind the development of universities, but also plays a very important role in human resources of higher education institutions. This paper describes a few novel approaches to overcome the current problems in the management of university counselors, especially in the work of performance appraisal operations and theories. Finally, a performance appraisal system for university counselors is put forwarded and some new solutions are explored in the university human resources management.

Keywords: private colleges, counselors, performance appraisal.

1 Introduction

With the rapid development of education reform, higher school education has been changed from elite education to mass education.[1] In this case, the consequences are that each student faces the pressure of learning and employment pressure. On the one hand, higher schools or education institutions want to provide high quality education; on the other hand, students hope that their alma mater can provide quality educational resources, and also hope that the colleges can offer them the professional guidance of career planning, employment and psychological to help them to have a fulfilling college life. This becomes an important issue which has to be treated with.

The internal and external environments that private colleges face even more severely.[2] Thus, private colleges must improve their teaching level, and at the same time, must continuously improve their management level to adapt to the changes of external environment. Counselors are the main role in the political education and play an important role in the work of cultivating talent. They help students to establish a correct world view, philosophy and they directly affect the shaping of ability and their overall development.

Constructing a high-level counselors team is becoming to an important work in the field of human resource management. So, this paper applies itself to improve the quality of counselors from performance appraisal management to meet the need of school management and the students' educational activities.[3]

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2 Basic Theories

2.1 Performance

The definition of performance refers to the employees` behavior to achieve the target and the effective implementation of effective work under a certain time and condition.

In an organization, what you do and how to do are equally important, outstanding performance depends not only on the results, but also on work behavior. Only when the conduct and results have tended to be benign at one time, excellent performances appear. [4]

The performance has four features:

a) More factors. The factors affect the performance includes subjective factors and objective factors.
b) Multi-dimensional. Staff performance can be displayed through a number of indicators.
c) Dynamics. Staff performance is not static, it is through their own efforts can achieve better performance, managers can not because of one thing or the first assessment and conclusions to the next staff.
d) Measurable. Employee performance can be quantified, we can see to the management.[5]

2.2 Performance Appraisal

The definition of performance appraisal is the process that for the sake of achieving the production and business purposes an enterprise uses specific standards and targets, takes a scientific approach, values the Staff` task performance and the resulting effect who undertake the production process and results.

The methods of performance appraisal are as follows:

a) Alternative Ranking Method (ARM). It is a more common sort of assessment method. The principle is: picking out the best performance and the worst performance in the group. This is easier than comparing an absolute performance assessment. Then it selects the "second best" and the "second worst", so in turn, until all staff are arranged. ARM can also be used in the performance of sorting tables.
b) Paired Comparison Method (PCM). It is a more detailed assessment method, which is characterized by each person should be compared with everyone else, and sorts the winner one, finally it ranges all staff by the win frequency.
c) Forced Distribution Method (FDM). This method is prior to carry out the ratio of performance distribution, and all the evaluation results of staff are arranged.
d) Critical Incident Method (CIM). This method values level of the performance by employees` behavior and their results. Generally the director records Good or bad behavior and events, the director should talk with the employees in the assessment time point (every quarter or every six months), according to the discussing, make the level of their performance appraisal.
e) Behaviorally Anchored Rating Scale (BARS). It is based on work by assessing the behavior of those observations, assessment, and thus assesses employees performance levels.

f) Management by Objectives (MBO). MBO is an approach which is used more abroad today, and it can be used in many fields. Managers attach importance to the index of profits, sales and cost which can bring the good results. In the MBO, each employee have a number of specific indicators, which is the key to successful implementation of its work objectives, its completion can be used as a basis for evaluation.

2.3 The Principles of Performance Appraisal

a) Changing concept of managers and counselors. It is the important ways to strengthen the college counselors to establish a scientific counselor performance appraisal system and strictly to enforce in accordance with system. University administrators must deeply understand this. Counselors should recognize the purpose of performance appraisal is to make their long-term development and to improve their job performance, not to punish them.
b) Feedback. Feedback is good for effective guidance to the work of counselors, and it can help to discover the problems of work, in the next cycle of performance counselors may achieve good results. Managers should carefully analyze the appraisal results, and timely show it to the counselor in the form of a written report. Counselors can evaluate results, detect their own problems, identify the next targets, target to improve and upgrade their ability to work, and gradually realize their personal career goals.
c) Adhering to a combination of qualitative and quantitative assessment. Counselor performance appraisal is a process evaluation, rather than simply the result evaluation. College counselors should lay down quantitative indicators and qualitative performance appraisal according with the actual development, the indicator should be set not be excessively tight and detailed, it should focus on the important work, and reflect the organization's strategic development requirements.
d) Objective principle. In the daily work, it is necessary to collect and preserve the original data to ensure the authenticity of the assessment. These raw data consists of two parts: the work records of retaining by counselor themselves, such as the record of individual talking with the students, organizing and participating in student activities and meetings records; Second, student management records, such as the number of visits to student, duty records of night classes.
e) Scientific principle. The counselors` work is different because of the specific division of labor, their task is different, so there must be some differences in assessment indicators. It should be so careful to chosen evaluators to avoid the situation that layman assess expert.[6]

3 Designing Performance Appraisal System

3.1 Selecting the Evaluators

Evaluators are 360-degree, including the supervisor, colleagues, students and themselves.

The weight of evaluators should distribute on the base of actual situation.

3.2 Determining the Assessment Time

This includes the choice of the assessment time and performance cycle. Counselor is the general staff with some particularity. The teaching work of higher education arrange with semester system, so the appraisal of counselor should be selected in the end or period of each semester as well, and 1-2 times a semester[7].

3.3 Appraisal Content

Some work of counselors can not be manifested easily, so it is difficult to measure their performance. This paper concerns about the competency and job performance. There are ideological quality, language skills, innovation, organizational skills, interpersonal skills, service sense, organizational identification, responsibility, dedication, target completion rate.

3.4 Appraisal Methods

This paper uses rating scale method to assess counselors` performance. It divides the appraisal content into several separate modules, and accurately describes the standards of each module.

Rating scales are shown in the following table, Table 1.

Table 1. Counselor performance rating scale

Name of employee:_____Department:_____Position:_____									
Evaluation scale and scores: Outstanding(10) Excellent(8) Good(7) General(6) Poor(4) Very poor(1)									
Appraisal content and weight		Supervisor		Colleagues		Students		Self	
		Appraisal	Score	Appraisal	Score	Appraisal	Score	Appraisal	Score
Ideological quality	20%								
Language skills	5%								
Innovation	5%								
Organizational skills	5%								
Interpersonal skills	5%								
Service sense	5%								
Organizational identification	5%								
Responsibility	5%								
Dedication	5%								
Target completion rate	40%								
Subtotal									
The proportion of evaluators		30%		10%		40%		20%	
Total									
Assessment Level	Excellent(≥90) Good(≥80) Competent(≥60) Incompetent (<60)								
The overall assessment: Evaluators: Date:									

4 Conclusions

This paper mainly studies some new performance management methods for university counselors. With these solutions, constructing a novel counselor performance appraisal system, providing a completely decision-making architecture for private education management. Last but by no means not important, this performance appraisal system can also be expanded to other human management resources fields, exploring some scientific methods for the human resources performance appraisal.

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The Traits of Multiple Vector Wavelet Functions Associated with Filter Functions

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Abstract. In this note, we introduce matrix-valued multiresolution analysis and orthogonal matrix-valued wavelet wraps. We demonstrate that there exist wavelet frame generated by two functions which have good dual wavelet frames, but for which the canonical dual wavelet frame does not consist of wavelets, according to scaling functions.. In particular, a new orthogonal basis of L2(R,Cs×s) is drawn from these wavelet wraps. The pyramid decomposition scheme is obtained.

Keywords: multiresolution analysis, orthogonal, matrix-valued wavelet wraps, orthogonal basis, unitary extnsion principle, time-frequency analysis method.

1 Introduction

Wavelet analysis has become a popular subject in scientific research for twenty years. such as signal processing, image processing and digital communication. Wavelet packets[1], due to their nice charact-eristics, have been applied to signal processing[2], image compression[3], coding theory and so on. Cohen and Daubechies[4] introduced the notion of biorthogonal wavelet wraps. Yang [5] constructed a-scale orthogonal multiwavelet packets which were more flexible in applications. In recent years, multi-wavelets have become a popular to tool in signal processing Matrix-valued wavelets are a kind of special multiwavelet. Xia[6] and Suter introduced the notion of matrix-valued wavelets and investigated the construction of matrix-valued wavelets. A typ-ical example of such matrixr-valued signals is video images. In addition, wavelet wraps provide better frequency localization than wavelets while time-do-main localization is not lost. Thus, it is necessary to extend the concept of orthogonal wavelet packets to the case of orthogonal matrix-valued wavelets.

Let $\mathbb{R}$ and $\mathbb{C}$ denote all real and all complex numbers, respectively. $\mathbb{Z}$ and $\mathbb{Z}_+$ stand for, respectively, all inters andnonnegative integers. Set $s \in \mathbb{Z}$ be a constant and $s \geq 2$. The signal space $L^2(R, C^{s\times s})$ is defined to be the set of all matrix-valued functions $H(t)$, i.e.,

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$$H(t)=\begin{pmatrix} h_{11}(t) & h_{12}(t) & \cdots & h_{1s}(t) \\ h_{21}(t) & h_{22}(t) & \cdots & h_{2s}(t) \\ \cdots & \cdots & \cdots & \cdots \\ h_{s1}(t) & h_{s2}(t) & \cdots & h_{ss}(t) \end{pmatrix},$$

where $h_{j,l}(t)\in L^2(\mathbb{R})$, $j,l=1,2,\cdots s$. Examples of matrix-valued signals are video images in which $h_{j,l}(t)$ denotes the pixel at the time t the j th row and the l th column. For an arbitrary $H(t)\in L^2(R,C^{s\times s}):=\ \|H\|_2=\sqrt{\sum_{j,k=1}^{s}\int_{\mathbb{R}}|h_{j,k}(t)|^2\,dt}$, and the integration of matrix-valued function $H(t)$ is defined to be $\int_{\mathbb{R}}H(t)dt:=\left(\int_{\mathbb{R}}h_{j,l}(t)dt\right)_{j,l=1}^{s}$, i.e., the matrix of the integral of every scalar functions $h_{j,l}(t)$, $j,l=1,2,\cdots,s$. For any $H(t)\in L^2(R,C^{s\times s})$, its Fourier transform is defined by

$$\widehat{H}(\omega):=\int_{\mathbb{R}}H(t)\cdot\exp\{-i\omega t\}\,dt. \tag{1}$$

For $\Lambda,\Gamma\in L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)$, their symbol inner product is defined by

$$\langle\Lambda,\Gamma\rangle:=\int_{\mathbb{R}}\Lambda(t)\cdot\Gamma(t)^{\dagger}dt \tag{2}$$

where $\dagger$ means the transpose and the complex conjugate.

Definition 1. A family $\{H_k(t)\}_{k\in\mathbb{Z}}\subset L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)$ is called an orthonormal basis in $L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)$, if it satisfies $\langle H_j,H_l\rangle:=\delta_{j,l}I_s\quad j,l\in\mathbb{Z}$, and $G(t)\in L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)$, there is a sequence of $s\times s$ constant matrice P_k such that $G(t)=\sum_{k\in\mathbb{Z}}P_kF_k(t)$, where I_s denotes the $s\times s$ identity matrix and $\delta_{j,l}$ =1 when $j=l$ and $\delta_{j,l}=0$ when $j\neq l$.

2 Matrix Multiresolution Analysis

Definition 2. A matrix-valued multiresolution analysis of $L^2(\mathbb{R},\mathbb{C}^{s\times s})$ is a nested sequence of closed subspaces $\{V_j\}_{j\in\mathbb{Z}}$, with the properties that

(a) $\cdots V_j \subset V_{j+1} \subset V_{j+2} \cdots$;

(b) $F(t) \in V_0 \Leftrightarrow F(2^j t) \in V_j$;

(c) $\bigcap_{j\in\mathbb{Z}} V_j = \{0\}$;

$Clos_{L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)}\left(\bigcup_{j\in\mathbb{Z}} V_j\right) = L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)$;

(d) There is a $F(t) \in V_0$ such that its translations $F_k(t) := F(t-k)$, $k \in \mathbb{Z}$, constitute an orthonormal basis for V_0.

Since $F(t) \in V_0 \subset V_1$, there exists a sequence of constant $s\times s$ matrices $\{A_k\}_{k\in\mathbb{Z}}$ such that

$$F(t) = 2\cdot\sum_{k\in\mathbb{Z}} A_k F(2t-k). \tag{3}$$

We say $F(t)$ is a scaling functions and eqation (6) a matrix dilation equation. Let

$$\underline{A}(\omega) = \sum_{k\in\mathbb{Z}} A_k \cdot \exp\{-ik\omega\}, \quad \omega\in\mathbb{R}. \tag{4}$$

Thus, equation (3) becomes $\widehat{F}(2\omega) = \underline{A}(\omega)\cdot\widehat{F}(\omega)$

Let W_j ($j \in Z$) be the complementary subspace of V_j in V_{j+1} and there exist a matrix-valued functions $G(t) \in W_0$ such that $G(t-k)$, $k \in \mathbb{Z}$, constitutes a Riesz basis of W_0. Obviously $G(t) \in W_0 \subset V_1$, Hence there exists a $s\times s$ finitely supported matrix sequence $\{B_k\}_{k\in Z}$ such that

$$G(t) = 2\cdot\sum_{k\in\mathbb{Z}} B_k F(2t-k), \tag{5}$$

By implementing Fourier transform for both sides of (8), we have

$$\widehat{G}(\omega) = \underline{B}(\omega/2)\widehat{G}(\omega/2), \quad \omega\in\mathbb{R}, \tag{6}$$

$$\underline{B}(\omega) = \sum_{k\in\mathbb{Z}} B_k \cdot \exp\{-ik\omega\}, \quad \omega\in\mathbb{R}. \tag{7}$$

We say that a scaling function $F(t) \in L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)$ is orthonormal, if

$$\left\langle F(\cdot), F(\cdot-k)\right\rangle = \delta_{0,k} I_s, \ k\in\mathbb{Z}. \tag{8}$$

We call $G(t) \in L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)$ a orthonormal matrix -valued wavelet functions associated with an orthonormal matrix-valued scaling functions $F(t)$ if they satisfy

$$\left\langle F(\cdot), G(\cdot-k)\right\rangle = \mathrm{O}, \ k\in\mathbb{Z}, \tag{9}$$

$$\left\langle G(\cdot), G(\cdot - k)\right\rangle = \delta_{0,k} I_s,\ k \in \mathbb{Z}. \tag{10}$$

Lemma 1. Let $\Gamma(t) \in L^2\left(\mathbb{R}, \mathbb{C}^{s\times s}\right)$. Then $\Gamma(t)$ is orthogonal if and only if

$$\sum\nolimits_{k\in\mathbb{Z}} \hat{\Gamma}(\omega + 2k\pi)\hat{\Gamma}(\omega + 2k\pi)^{\dagger} = I_s, \omega \in \mathbb{R}. \tag{11}$$

Lemma 2.[6] If $G(t) \in L^2\left(\mathbb{R}, \mathbb{C}^{s\times s}\right)$ be an orthogonal matrix vector -valued wavelet function associated with the orthogonal multiple vector -valued scaling functions $F(t)$, then

$$\underline{A}(\omega)\underline{A}(\omega)^{\dagger} + \underline{A}(\omega+\pi)\underline{A}(\omega+\pi)^{\dagger} = I_s. \tag{12}$$

$$\underline{A}(\omega)\underline{B}(\omega)^{\dagger} + \underline{A}(\omega+\pi)\underline{B}(\omega+\pi)^{\dagger} = O. \tag{13}$$

$$\underline{B}(\omega)\underline{B}(\omega)^{\dagger} + \underline{B}(\omega+\pi)\underline{B}(\omega+\pi)^{\dagger} = I_s. \tag{14}$$

3 Matrix-Valued Wavelet Wraps

To define matrix-valued wavelet wraps, we set $\Psi_0(t) = F(t)$, $\Psi_1(t) = G(t), P_v^{(0)} = A_v$, $P_v^{(1)} = B_v$.

Definition 3. A family of matria-valued functions $\{\Psi_{2n+\lambda}(t), n = 0,1,2, \cdots, \lambda = 0,1\}$ is said to be matrix wavelet wraps with respect to the orthogonal matrix scaling functions $F(t)$, where

$$\Psi_{2n+\lambda}(t) = 2\cdot\sum\nolimits_{k\in\mathbb{Z}} P_k^{(\lambda)}\Psi_n(t), \lambda = 0,1. \tag{15}$$

Taking Fourier transform for (20) yields

$$\widehat{\Psi}_{2n+\lambda}(2\omega) = \underline{P}\lambda(\omega)\widehat{\Psi}_n(\omega),\ \omega \in \mathbb{R}, \tag{16}$$

$$\underline{P}^{(\lambda)}(\omega) = \sum\nolimits_{v\in\mathbb{Z}} P_v^{(\lambda)} \cdot \exp\{-iv\omega\},\quad \omega \in \mathbb{R}. \tag{17}$$

Theorem 1. If $\{\Psi_n(t), n = 0,1,2,\cdots\}$ is matrix-valued wavelet wraps with respect to the orthogonal matrix scaling functions $F(t)$, then

$$\left\langle \Psi_n(\cdot), \Psi_n(\cdot - k)\right\rangle = \delta_{0,k} I_s,\quad n \in \mathbb{Z}_+,\ k \in \mathbb{Z}. \tag{18}$$

Proof. (i) Formula (18) holds by (8) as $n = 0$. (ii) Assume that formula (18) holds for $0 \le n < 2^{\ell_0}$ where ℓ_0 is a constant positive integer. Then, in the case of $2^{\ell_0} \le n < 2^{\ell_0+1}$, we have $2^{\ell_0-1} \le [n/2] < 2^{\ell_0}$. Here and afterwards,

$[x]=\max\{\rho\in\mathbb{Z},\rho\le x\}$. Therefore, $n=2[n/2]$, $+\tau,\tau=0,1$. According to Lemma 1. and the induction assumption, we obtain

$$\left\langle \Psi_{[n/2]}(\cdot),\Psi_{[n/2]}(\cdot-k)\right\rangle=\delta_{0,k}I_s \Leftrightarrow$$

$$\sum\nolimits_{k\in\mathbb{Z}}\widehat{\Psi}_{[n/2]}(\omega+2k\pi)\widehat{\Psi}_{[n/2]}(\omega+2k\pi)^{\dagger}=I_s,$$

Then we have

$$\sum\nolimits_{k\in\mathbb{Z}}\widehat{\Psi}_{n}(2\omega+2k\pi)\widehat{\Psi}_{n}(2\omega+2k\pi)^{\dagger}=$$

$$\underline{P}^{(\tau)}(\omega)\underline{P}^{(\tau)}(\omega)^{\dagger}+\underline{P}^{(\tau)}(\omega+\pi)\underline{P}^{(\tau)}(\omega+\pi)^{\dagger}=I_s.$$

Thus, (25) holds by Lemma 1 for $2^{\ell_0}\le n<2^{\ell_0+1}$. This completes the proof .

Theorem 2. Let $\{\Psi_n(t),n=0,1,2,\cdots\}$ is a matrix-valued wavelet wraps concerning the orgonal matrix scaling functions $F(t)$. Then

$$\left\langle \Psi_{2n}(\cdot),\Psi_{2n+1}(\cdot-k)\right\rangle=O,\quad n\in\mathbb{Z}_+,k\in\mathbb{Z}. \tag{19}$$

Proof. $\left\langle \Psi_{2n}(\cdot),\Psi_{2n+1}(\cdot-k)\right\rangle$

$$=(1/2\pi)\int_0^{4\pi}\underline{P}^{(0)}(\omega/2)\{\sum\nolimits_{l\in\mathbb{Z}}\widehat{\Psi}_n(\omega/2+2l\pi)^{\dagger}$$

$$\cdot\widehat{\Psi}_n(\omega/2+2l\pi)^{\dagger}\}\cdot\underline{P}^{(1)}(\omega/2)^{\dagger}\cdot e^{ik\omega}d\omega$$

$$=\frac{1}{2\pi}\int_0^{2\pi}\{\underline{P}^{(0)}(\omega/2)\underline{P}^{(1)}(\omega/2)^{\dagger}$$

$$+\underline{\Omega}^{(0)}(\omega/2+\pi)\underline{\Omega}^{(1)}(\omega/2+\pi)^{\dagger}\}\cdot e^{ik\omega}d\omega=O$$

Theorem 3. If $\{\Psi_\ell(t),\ell=0,1,2,\cdots\}$ is a matrix-valued wavelet wraps with respect to the orthogonal matrix scaling functions $F(t)$, then for $m,n\in\mathbb{Z}_+\bigcup\{0\}$, we have

$$\left\langle \Psi_m(\cdot),\Psi_n(\cdot-k)\right\rangle=\delta_{m,n}\delta_{0,k}I_s,\quad k\in\mathbb{Z}.$$

Proof. Formula (19) holds for $m=n$ by Theorem 2.For the case of $m\ne n$, without loss of generality, we assume $m>n$. We can write m,n as $m=2[m/2]+\tau_1$, $n=2[n/2]+\rho_1$, where

$\tau_{1,}\rho_1 = 0,1$. (i) If $[\mathrm{m}/2]=[\mathrm{n}/2]$, then $\tau_1 \neq \rho_1$. By (16), (17) and (28), we get that

$$\left\langle \Psi_m(\cdot), \Psi_n(\cdot - k) \right\rangle = \frac{1}{\pi}\int_0^{\pi} [\underline{P}^{(\tau_1)}(\omega)\underline{P}^{(\rho_1)}(\omega)^{\dagger}$$
$$+\underline{P}^{(\tau_1)}(\omega+\pi)\underline{P}^{(\rho_1)}(\omega+\pi)^{\dagger}] \cdot \mathrm{e}^{2ik\omega}\, d\omega = O.$$

(ii) For $[\mathrm{m}/2] \neq [\mathrm{n}/2]$. Let $[m/2] = 2[[m/2]/2]$

$+\tau_2$, $[n/2] = 2[[n/2]/2] + \rho_2$,where $\tau_{2,}\rho_2 = 0,1$.

If $[[m/2]/2] = [[n/2]/2]$, then (22) holds similarly to case (i) .Provided that $[[m/2]/2] \neq$, $[[n/2]/2]$ .we order $[[m/2]/2] = 2[[[m/2]/2]/2]$, $[[n/2]/2] = 2[[[n/2]/2]/2] + \tau_3 + \rho_3$, $\tau_{3,}\rho_3 = 0,1$. · · · · Thus, after having finite steps denoted as κ, we obtain two cases:

$$* \overbrace{[[\cdots[m/2]/2\cdots]/2]}^{\kappa} = 1, \quad \overbrace{[[\cdots[n/2]/2\cdots]/2]}^{\kappa} = 1;$$

$$* * \quad \overbrace{[[\cdots[m/2]/2\cdots]/2]}^{\kappa} = 1, \overbrace{[[\cdots[n/2]/2\cdots]/2]}^{\kappa} = 0.$$

For case $*$, (19) holds similar to case (1). In respect of case $* *$, we get ,by (9), (18) that

$$\sum_{k\in\mathbb{Z}} \widehat{\Psi}_1(\omega+2k\pi)\widehat{\Psi}_0(\omega+2k\pi)^{\dagger} = O,, \quad \omega \in \mathbb{R}.$$

$$\left\langle \Psi_m(\cdot), \Psi_n(\cdot - k) \right\rangle$$

$$= \frac{1}{2\pi}\int_0^{2^{\kappa+1}\pi} \prod_{\sigma=1}^{\kappa} \underline{P}^{(\tau_\sigma)}(\omega/2^{\sigma}) \cdot O \cdot \prod_{\sigma=1}^{\kappa} \underline{P}^{(\rho_\sigma)}(\omega/2^{\sigma})^{\dagger}$$

$$\cdot \exp\{ik\omega\}\, d\omega = O.$$

Therefore, for any $m, n \in \mathbb{Z}_+ \bigcup \{0\}$ and $k \in \mathbb{Z}$, formula (19) follows.

Let $X_j^n = \mathbf{clos}_{L^2\left(\mathbb{R},\mathbb{C}^{s\times s}\right)} \left\langle \Psi_n\left(2^j \cdot - k\right) : k \in \mathbb{Z} \right\rangle$,

$j \in Z$, Then $X_j^0 = V_j$; $X_j^1 = W_j$, $j \in Z$.

Proposition 1. If $n \in \mathbb{Z}_+$, then $X_{j+1}^n = X_j^{2n} \oplus X_j^{2n+1}$, $j \in Z$.

Corollary 1. For $j\in \mathbb{Z}_+$, $k=1,2,\cdots j$, we have

$$W_j = X_{j-k}^{2^k} \oplus X_{j-k}^{2^k+1} \oplus \cdots \oplus X_{j-k}^{2^{k+1}}.$$

Corollary 2. If $\{\Psi_n(t), n=0,1,2,\cdots\}$ is a matrix-valued wavelet packets with respect to $F(t)$ and X_j^n, $j\in Z$, is defined as the above, then

$$L^2(\mathbb{R},\mathbb{C}^{s\times s}) = \oplus_{j\in\mathbb{Z}} W_j = \cdots \oplus W_{-1} \oplus W_0 \oplus_{\ell=2}^{\infty} X_0^{\ell}$$

For simplicity, we introduce a dilation operator $(DH)(t)=H(2t)$, where any $H(t)\in$

$L^2(\mathbb{R}^n,\mathbb{C}^{s\times s})$, and set $\mathrm{D}\Gamma=\{DH(t): H(t)\in\Gamma\}$,
where $\Gamma\subset L^2(\mathbb{R}^n,\mathbb{C}^{s\times s})$.

For any $\beta\in Z_+^s$, define

$$\Gamma_\beta = \{G(t): G(t)=\sum\nolimits_{k\in Z^n} C_k \Psi_\beta(t-k),\ \{C_k\}\in \ell^2(Z^n)^{s\times s}\}. \tag{20}$$

where the family $\{\Psi_\beta(t),\ \beta\in Z_+^s\}$ are the matrix-valued wavelet packets with respect to the orthogonal matrix-valued function $F(t)$, Therefore, it follows that $\Gamma_0=V_0$, $\Gamma_\lambda=W^{(\lambda)}$, where $\lambda\in\Omega=\{1,2,\cdots,2^n-1\}$. Then we obtain the following important lemma. Assuming that $(P^{(\lambda)}(2^{-1}(\omega+2\pi\mu)))_{\lambda,\mu\in\Omega_0}$ is a unitary matrix.

Lemma 3. For arbitrary $\beta\in Z_+$, the space $D\Gamma_\beta$ can be orthogonally decomposed into spaces $\Gamma_{2\beta+\lambda}, \lambda\in\Omega_0$ *i.e.*,

$$D\Gamma_\beta = \oplus_{\lambda\in\Omega_0}\Gamma_{2\beta+\lambda}. \tag{21}$$

For any $j\in Z_+$, define the sets $j\Delta=\{\alpha=(\alpha_1,\alpha_2$
$,\cdots,\alpha_s\}\in Z_+^s-\{0\}: 2^{j-1}\le\alpha_l\le 2^j-1, 1\le l\le s\}$.

Theorem 4. The family $\{\Psi_\alpha(\cdot-u),\ \alpha\in j\Delta,\ u\in Z^s\}$ forms an orthogonal basis of $\mathrm{D}^j\mathrm{W}_0$. In particular, $\{\Psi_\alpha(\cdot-u), \alpha\in Z_+, u\in Z^s\}$ constitutes an orthonormal basis of $L^2(\mathbb{R}^n,\mathbb{C}^{s\times s})$.

Proof. According to formula (28), we have $DQ_0=\oplus_{\lambda\in\Omega_0}Q_\lambda$, i.e., $D\Gamma_0=\Gamma_0\underset{\lambda\in\Omega}{\oplus}\Gamma_\lambda$.

Since $\Gamma_0 = V_0$ and $W_0 = \bigoplus_{\lambda\in\Omega} W_0^{(\lambda)} = \bigoplus_{\lambda\in\Omega} \Gamma_\lambda$, hence

$D\Gamma_0 = V_0 \oplus W_0$. It can inductively be proved by using relation (21) and the above equation that

$D^j\Gamma_0 = D^{j-1}\Gamma_0 \bigoplus_{\alpha\in j\Delta} \Gamma_\alpha$. Due to $V_{j+1} = V_j \oplus W_j$,

thus it gets that $D^j\Gamma_0 = D^{j-1}\Gamma_0 \oplus D^{j-1}W_0$. By (31) and Theorem 1, we have

$$L^2(\mathbb{R}^n, \mathbb{C}^{s\times s}) = V_0(\bigoplus_{j\geq 0} D^j W_0)$$

$$= \Gamma_0 \oplus (\bigoplus_{j>0} (\bigoplus_{\alpha\in j\Delta} \Gamma\alpha)) = \bigoplus_{\alpha\in Z_+^s} \Gamma_\alpha. \tag{22}$$

By Theorem 3, for $\alpha \in Z_+^s$, the family $\{\Psi_\alpha(\cdot - u),\ u \in Z^s\}$ is an orthogonal basis of Γ_α. Moreover, by (25), $\{\Psi_\alpha(\cdot - u),\ \alpha \in Z_+^s,\ u \in Z^s\}$ form an orthogonal basis of $L^2(\mathbb{R}^n, \mathbb{C}^{s\times s})$.

4 Conclusion

The orthogonality property of univariate matrix-valud wavelet wraps is investigated. The concept of orthogonal matrix-valued wavelet wraps of space $L^2(\mathbb{R}^n, \mathbb{C}^{s\times s})$ is also introduced. Their properties are studied by virtue of time-frequency analysis ethod, matrix theory and operator theory. A class of affine multiple pseudoframes for the subspaces of $L^2(R)$ is characterized.

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The New Approach of Applying DSM to Topology

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Abstract. A new approach for topology was proposed in the paper. The approach modified the method of DSM and introduced it into topology. The concept and process of the approach was given in detail. Two methods were provided and applied to the practical case. Compared to the traditional approach of topology, its concept was clear and its efficiency was high.

Keywords: DSM, topology, adjacent matrix, adjacency multilist.

1 Introduction

DSM (Design Structure Matrix) was proposed in 1981, it has the following advantages: 1) describe the composition and structure of the process system, in particular, coupling and loop structures; 2) simple, compact, visual, easy to communicate with users; 3) its matrix form makes qualitative and quantitative analysis combine in the algorithm. DSM's own characteristics make it more suitable for graph-based operator, after appropriate modifications, it can be used for the calculation of the topology, and improve the efficiency of the traditional topological algorithms.

2 DSM

DSM is a tool that manages dependencies between system design parameters. It was developed by Steward and refined by Eppinger [1] to manage large scale complex systems. Design structure matrix (DSM) is perhaps the most well known approach [2]. Within DSM, the design project is decomposed into n tasks. Tasks are then represented by a binary (0 or 1 entry) in n x n matrix. If a relationship exists between tasks i and j, then the value of element ij is expressed as one in the DSM, otherwise it takes a zero value. However, in its basic use, DSM is solely useful in representing the relationships between the various design tasks. To broaden its usefulness, many researchers have developed further applications for DSM in the area of managing design projects [3]. This algorithm generates a sequence of design tasks such that the number of cycles is minimized. Using a numerical DSM, Eppinger et al. [4] investigated different strategies form managing task procedures. On the basis of DSM, analytical methods have been developed by Smith and Eppinger [5], to help understand the effects of complex task coupling. On the basis of DSM, Su et al. [6] developed a method for measuring functional dependency and sequencing of coupled tasks in engineering design. Then, in

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terms of the measured coupling strengths, an algorithm has been suggested for finding the best processing sequence of the coupled tasks. To help organizing teams for concurrent engineering projects, Chen and Lin [7] proposed a methodology for decomposing interdependent design tasks into groups. For better management of concurrent activities, Yassine and Braha [8] proposed a DSM-based model for representing complex task relationships. For managing complex design projects, Cho and Eppinger [9] developed a simulation-based process model that uses DSM to capture the information flow between tasks. Most recently, Zhang et al. [10] proposed to measure the coupled strength between design tasks in terms of interface parameters. On the basis of this measure, a method was constructed for sequencing the coupled design tasks.

There has already been an excellent review by Browning [11] in general areas of DSM application. They categorized DSM models into four types according to their characteristics and applications:

1) Component-Based DSM: which documents interactions among product components, can be used to facilitate appropriate modularization of a complex system;
2) Team-Based DSM, useful for depicting the interactions among design teams;
3) Activity-Based DSM, effective in modeling the information dependencies among design activities;
4) Parameter-Based DSM, for documenting physical design parameter relationships.

3 DSM Topological Sort

DSM-sorting process is as follows: Identify all the beginning of activities, because they do not need any input, so they can be done first. The corresponding row and column to the beginning were placed on the top row and the left column in the DSM; identify all terminal activities, they do not provide output to other activities, so you can put the final implementation. They are placed in its corresponding row on the bottom of the DSM, the corresponding column on order right; no longer consider the client activities, repeat the process in the remaining activities. The above features make it possible to sort based on DSM[12].

3.1 Process of the DSM Topological Sort

Most circumstances (such as AOV network) in topological sort is not allowed to ring there, so have to consider the ring and modify the algorithm, the topological sorting method based on DSM is gained as follows[13]:

Step.1: Fill in the vacancy of adjacent matrix A with '0' and '1'. Put '1' on a_{ij} (the intersection of two activities) which have information flow from activity i to j and put '0' on which have no information flow.

Step.2: If all the elements of a row on A are zero, the activity responding to this row should be executed as early as possible, because it is the original point of the whole activity process and does not need any information of other activities. We adjust it on the first column and row on ***A.***.

If all the elements of a column are zero, the activity responding to this column should be executed behind other activities, because it is the terminal point and provides no information to the others. We put it on the last column and row on ***A*..**

In a similar way, we can adjust other activities on *A* in turn.

Set the number of activities 'n', if there is no ring in the activities, then the process through (n +1) / 2 times, all sort of activities will be completed.

Otherwise, there are loops in the entire path and the process of the topology algorithm stops.

Taked into account the specific storage, DSM topological sort method can be implemented in two ways:

3.2 Adjacency Matrix Method

An adjacency matrix of Figure 1is showed as follows:

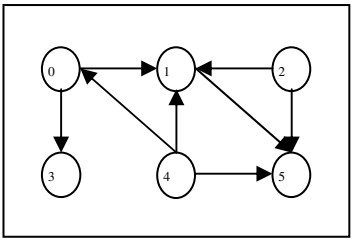


Fig. 1. AOV network

$$\begin{pmatrix} 0 & 0 & 0 & 0 & c_4 & 0 \\ c_0 & 0 & c_2 & 0 & c_4 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ c_0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & c_1 & c_2 & 0 & c_4 & 0 \end{pmatrix}$$

In the matrix, all the elements of the third row are zero, that means Activity 'c_2' is the source point of the whole activity process and adjust on the first row and column; and all the elements of the sixth column are zero, it is the terminal point and put on the last column and row. And then the matrix is showed as $\boldsymbol{A}_1$:

$$A_1=\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ c_2 & 0 & c_0 & 0 & c_4 & 0 \\ 0 & 0 & 0 & 0 & c_4 & 0 \\ 0 & 0 & c_0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ c_2 & c_1 & 0 & 0 & c_4 & 0 \end{pmatrix}$$

$$A_2=\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & c_4 & 0 & 0 & 0 & 0 \\ c_2 & c_4 & c_0 & 0 & 0 & 0 \\ 0 & 0 & c_0 & 0 & 0 & 0 \\ c_2 & 0 & 0 & c_1 & c_4 & 0 \end{pmatrix}$$

In the left activities, all the elements of the fifth row (c_4) are zero, that means Activity 'c_4' is the sub-source point of the whole activity process and adjust on the second row and column; and all the elements of the fourth column (c_3) are zero, it is the sub-terminal point and put on the (n-2)th column and row. And then the topology sequence is: (c_2 c_4 -- c_3 c_5), the matrix is showed as $\boldsymbol{A}_2$.

Then the left activities are c_0 and c_1, now the topology sequence is: c_2 c_4 c_0 c_1 c_3 c_5.

$$\begin{pmatrix} & \\ 0 & 0 \\ c_0 & 0 \\ & \end{pmatrix}$$

For the general case, by using DSM topological sort, n-first search can find source and sink points of the entire sequence, respectively, on the matrix of its first row, first column, Row *n-1* and Column *n-1*; then search sub-level source and sink points for (n-2) times in the remainder (*n-2*)*(*n-2*) matrix; so, if there is no ring, when n is even, the algorithm is executed k times:

$$k = (n + n - 2 + ... + 2) = n(n + 2)/4$$

When n is odd, the algorithm is executed:

$$k = (n + n - 2 + ... + 1) = (n + 1)(n + 1)/4$$

As for the traditional topology algorithm, in worst case, the number of sorting is:

$$k = (n + n - 1 + ... + 1) = n(n+1)/2$$

This shows that the algorithm has the advantage of a simple idea, because in both directions on the search, the sorting number of the algorithm is half of the original algorithm, but the algorithm's time complexity is still O(*n2*). Efficiency can be improved by the adjacent multi-table method, which is done below.

3.3 Adjacent Multi-table Method

Adjacency matrix is generally sparse, to improve the efficiency of the algorithm, adjacent multiple table of Fig. 1 is show as Fig.2:

In the Structure, two special arrays are added: Cnt0 is used to store in-degree value of nodes, '0' means no predecessor; Cnt1 is used to store the out-degree value of nodes, '0' means no successor. The values can be obtained during multiple tables being constructed.

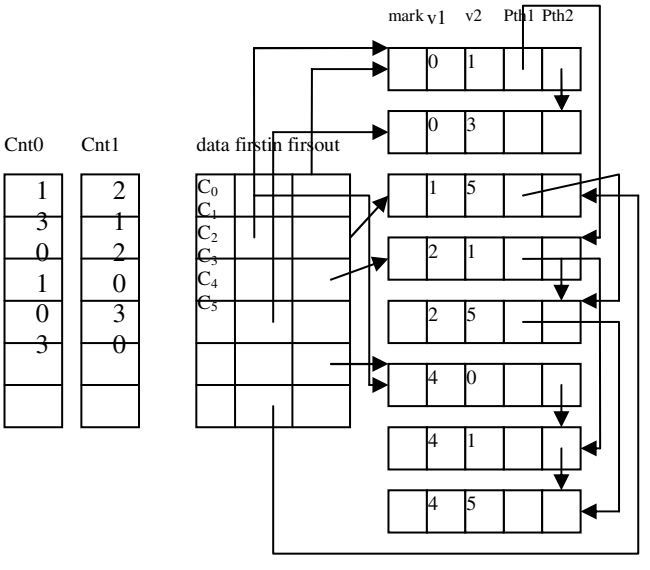
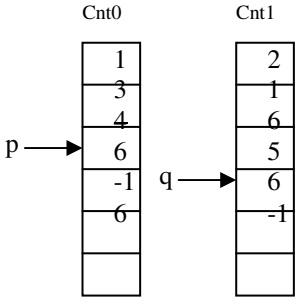


Fig. 2. Adjacent multiple table

Then scanning Cnt0 and Cnt1, if in-degree value of an element is '0' , add the element to the chain lead by the 'p', and set 'n' to its out-degree value; if out-degree value of an element is '0' , add the element to the chain lead by the 'q', and set 'n' to its in-degree value. And then the Cnt0 and Cnt1 become as follows:



First, scan the edge node of multiple adjacent table along the *'firstout'* pointer of the element '*p*': If the node out-degree value is not 'n' and 'mark' field is not '1', reduce its in-degree value by 1 and modify the 'mark' field to "1", if in-degree value was reduced to '0', add the element to the chain lead by the 'p', and set 'n' to its out-degree value, this process continues along path2 domain of edge nodes until the domain is null. At the same time, p point to the Cnt0[p].

Then, scan the edge node of multiple adjacent table along the *'firstin'* pointer of the element '*q*': If the node in-degree value is not 'n' and 'mark' field is not '1', reduce its out-degree value by 1 and modify the 'mark' field to "1", if out-degree value was reduced to '0', add the element to the chain lead by the 'q', and set 'n' to its out-degree value, this process continues along path1 domain of edge nodes until the domain is null. q point to the Cnt1[q]

Next, the same process take place on next 'p' or 'q' until meet with '-1'. Now if the number of 'p' and 'q' is less than 'n', there are loops in the graph.

The algorithm input 'e' edges and look for their first '0' in-degree and out-degree no more than n times when establish adjacency table. And then look for other '0' in-degree and out-degree only 'e' edge nodes, so its time complexity is O(n+e).

4 Conclusion

The new Topological sort approach based on DSM is to identify the starting point of a sequence of activities and sink points, it look for its source and sink points from two directions at the same time, and its adjacency matrix method achieve a simple design ideas but the larger complexity; and the time complexity of its adjacent multi-table achieve muck lower and close to traditional topological sorting method. Because sweeping from its two (source and sink points) direction at the same time, so they use less time than the traditional topological sort's.

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Research and Design of Network Information Query System Based on MIDP

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Abstract. The integration of mobile devices and Web services makes mobile applications reach a new level. J2MEMIDP have received wide application. Web services can be easily accessed by using MIDP mobile applications. This article studies network information query System based on MIDP, designs and implements the system. Background database on the server side uses JDBC API to implement the connection to SQL Server2000. Through timely updating the database, end clients can easily inquire the weather information through the existing mobile communications network, this facilitates the travel of people.

Keywords: MIDP, J2ME, network information query, Mobile E-commerce.

1 Introduction

With the development of computer technology, the program development of mobile equipment gets the much more favor of developers. Java is a cross-platform language, and it is used for the development of the mobile equipment program to a great extent. Although there is the very comprehensive weather information data on Internet, after all, not everyone can whenever and wherever possibly use personal computers to surf the Internet. With the rapid development of information technology and 3G mobile communication network is put into operation in China, people hope to use the existing communication network, conveniently and quickly to obtain all kinds of information related closely to life. Information inquiry business has gradually become a new growth point of mobile business. Based on the above reasons, the query platform is designed based on MIDP technology, which is used for querying the weather information on the mobile communication terminals.

2 The Architecture of J2ME

J2ME is the abbreviation of Java 2 Micro Edition. It is the compact version of Java programming language. Many people didn't realize that Java was invented at the beginning for mobile device programming, and finally J2ME is used for achieving this purpose. J2ME includes a set of development tools and abundant application

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programming interface (API) to develop the mobile phone application program, known as the MIDlet.

In order to support a variety of flexibility configuration requirements of consumer and embedded market. J2ME uses modular and expansibility design. The modularing and expansibiliy of J2ME technology are realized through a four-layer software model. This four-layer software model is built on the local operating system.

The four software layers include Java virtual machine layer, configuration layer, profile layer and MIDP layer.

Java Virtual Machine layer: This layer is an implementation of a Java Virtual Machine that is customized for a particular device's host operating system and supports a particular J2ME configuration.

Configuration layer: The configuration layer defines the minimum set of Java Virtual Machine features and Java class libraries available on a particular category of devices. In a way, a configuration defines the commonality of the Java platform features and libraries that developers can assume to be available on all devices belonging to a particular category. This layer is less visible to users, but is very important to profile implementers.

Profile layer: The profile layer defines the minimum set of application programming interfaces (APIs) available on a particular family of devices. Profiles are implemented upon a particular configuration. Applications are written for a particular profile and are thus portable to any device that supports that profile. A device can support multiple profiles. This is the layer that is most visible to users and application providers.

MIDP layer: The Mobile Information Device Profile (MIDP) is a set of Java APIs that addresses issues such as user interface, persistence storage, and networking.

The Java Virtual Machine layer, configuration layer, and profile layer together constitute the Connected Limited Device Configuration (CLDC). The MID Profile and CLDC provide a standard runtime environment that allows new applications and services to be dynamically deployed on end-user devices.

3 The Architecture of MIDP

3.1 The MIDP Application

CLDC and MIDP provide a complete environment for creating applications on cell phones. MIDP application is also called MIDLet application, the building blocks of J2ME is showed in Fig. 1.

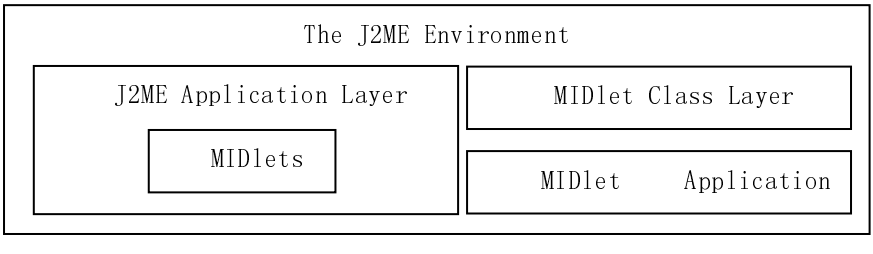

Fig. 1. The building blocks of J2ME

MIDlet application is the basic unit of MIDP application, it is the all kinds of cell phone application. In order to realize the data and resources sharing among many MIDlet applications, many MIDlet applications are packed into one jar file. The encapsulated MIDlet programs set is called MIDlet suite.

The MIDlet class layer provides the interface between the runtime environment(the application manager) and MIDlet application codes, realizes the program methods such as startApp(), pauseApp() and destroyApp(). These methods is similar to the methods such as start(), stop() and destroy() in java.appliet.Applet class.

Java application manager(JAM) is responsible for installing, upgrade, delete, start, stop and other general management of the MIDlet suite on a particular device. JAM provide the execution environment for the MIDlet suite.

3.2 The Life Cycle of MIDlet

Mobile devices interact with a MIDlet using their own software, which is called Application Management Software (AMS). The AMS is responsible for initializing, starting, pausing, resuming, and destroying a MIDlet. (Besides these services, AMS may be responsible for installing and removing a MIDlet, as well.) To facilitate this management, a MIDlet can be in one of three states which is controlled by the MIDlet class methods, that every MIDlet extends and overrides. These states are active, paused and destroyed, it is showed in Fig. 2.

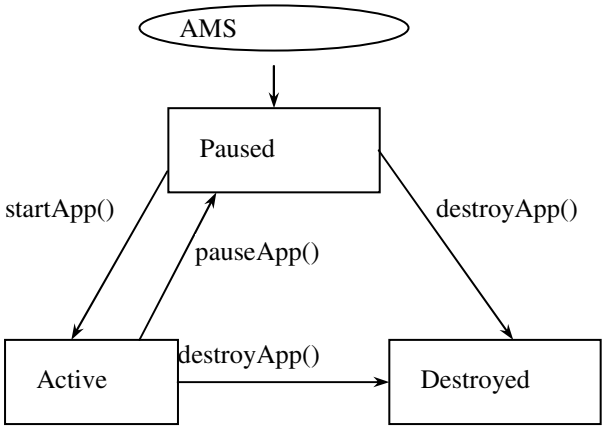

Fig. 2. The states and transition of MIDlet

An installed MIDlet is put into a paused state by the AMS creating an instance of it, by calling its no-arguments constructor. This is of course, not the only way that the MIDlet can be in a paused state. It can enter this state when the AMS calls the pauseApp() method on an active MIDlet (and the method returns successfully). It can also

enter this state when the MIDlet pauses itself by calling the notifyPaused() method, as opposed to the pauseApp() method, which is called by the AMS. However, what exactly is happening with the MIDlet in the paused state?

In a paused state, the MIDlet is waiting for a chance to get into the active state. Theoretically, in this state, it should not be holding or using any of the device resources and should be passive in nature. Once the MIDlet is created, this is the state to be in before becoming active. Also, entering the paused state is necessary when the device requires it to consume fewer resources, because these resources may be required for handling other device functions, like handling an incoming call. This is when the device invokes the pauseApp() method through the AMS. If the MIDlet should inform the AMS that it has paused, it should invoke the notifyPaused() method, which tells the AMS that the MIDlet has indeed paused.

One final way in which a MIDlet can get into a paused state is when the MIDlet's startApp() method, which is called when the AMS invokes it to start the MIDlet (either the first time or from a paused state), throws a MIDletStateChangeException. Essentially, in case of an error, the MIDlet takes the safe road of staying in the paused state.

The active state is where every MIDlet wants to be! This is when the MIDlet can do its functions, hold the device resources and generally, do what it is supposed to do. As said previously, a MIDlet is in an active state when the AMS calls the startApp() method on a paused MIDlet (actually, the MIDlet enters the active state just before this method is called by the AMS). A paused MIDlet can request to go into the active state by calling the method resumeRequest(), which informs the AMS that the MIDlet wishes to become active. The AMS may of course, choose to ignore this request or, alternatively, queue it if there are other MIDlets requesting the same.

The destroyed state is entered when a MIDlet's destroyApp(boolean unconditional) method is called and returns successfully, either from an active or paused state. This method is called by the AMS when it feels that there is no need for the MIDlet to keep running and is the place the MIDlet may perform cleanup and other last minute activities. The MIDlet can enter this state itself, by calling the notifyDestroyed() method, which informs the AMS that the MIDlet has cleaned up its resources and is eligible for destruction. Of course, since in this case, the destroyApp(boolean unconditional) method is not called by the AMS, any last-minute activities must be done before this method is invoked.

What happens if the AMS calls the destroyApp(boolean unconditional) method in the middle of an important step that the MIDlet may be doing, and may be loath to be destroyed? This is where the Boolean unconditional flag comes into the picture. If this flag is set to true, the MIDlet will be destroyed, irrespective of what the MIDlet is doing. However, if this flag is false, effectively, the AMS is telling the MIDlet that it wants the MIDlet to be destroyed, but if the MIDlet is doing something important, it can raise a MIDletStateChangeException, and the AMS will not destroy it just yet. However, note that even then, there are no guarantees that the MIDlet will not be destroyed, and it remains up to each device to decide how they should handle the request. If the device does honor the MIDlet's request, it may try and invoke the destroyApp(boolean unconditional) at a later stage.

Note that a destroyed state means that the MIDlet instance has been destroyed, but not uninstalled from the device. The MIDlet remains installed in the device, and a new instance of it may be created later.

4 The Design and Realization of Network Information Query System Based on MIDP

The main research content of this system is network information query based on MIDP, focuses on server-side development. This system is realized by three practical information query, such as weather forecast, phone numbers attribution, IP location.

4.1 The Design of Information Query Server-Side

The server side of information query is the hub of the entire system. It receives the client's query through the wireless communication, and analyzes the client request by the information sent by the client. It calls the different service module depending on the different needs and returns the results to the clients. The server can provide the queries such as weather information, phone numbers attribution, IP address location.

The weather information comes from the Internet web server. In order to speed up the response speed of the server, the server synchronizes the meteorological data to the local database with the meteorological server. After the meteorological information server has updated the data, the information query server connects to the meteorological sever for updating the local database, so the client can obtain the more accurate information. The specific design of server-side is as shown in Fig. 3.

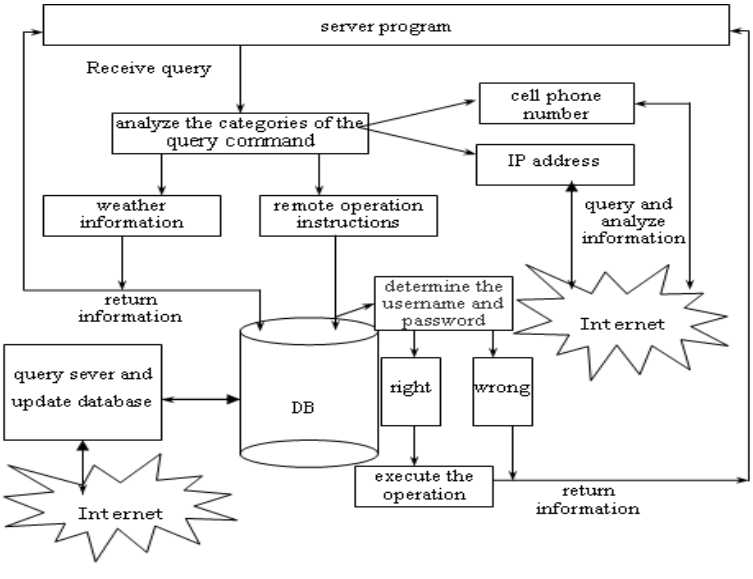

Fig. 3. The design of information query server-side

4.2 The Design of Information Query Client-Side

The function of the client-side is simpler. The client program is the cell phone application using J2ME development environment. Its function is that the mobile devices send the instructions to the information server via a wireless network. It uses the client software. At the same time it waits the server to return information, then displays the results. Because of the mobile device configuration, the client application should be short and pithy. This design uses the same interface, when the user inputs different instructions, it can execute the different query and operation. Thus the running speed is improved. The design of information query client-side is as shown in Fig. 4.

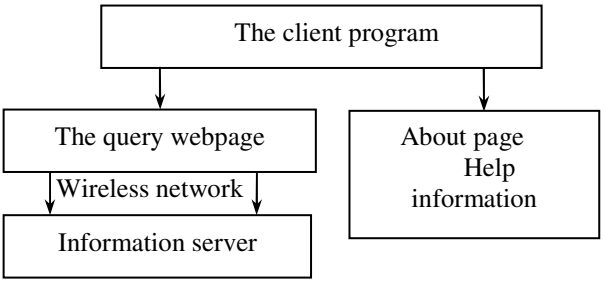

Fig. 4. The design of information query client-side

4.3 The Simple Operation Frame

In the three query modules, there are two kinds of working mode. The query of cell phone number and IP address uses the immediate query, it means that when the server receives the query instructions it queries the data from the specific serer. This is because the local data synchronization is difficult. The data amount of weather information is relatively smaller than cell phone number and IP address, so the local database is adopted to store the weather information of the various regions. This can significantly improve the server response time, and can solve the server consumes all resources because of receiving a large number of queries in a short time. The simple operation flow is shown in Fig. 5.

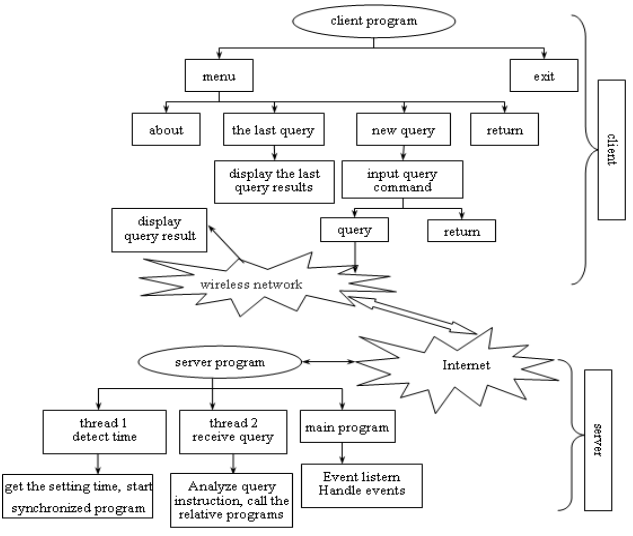

Fig. 5. The Simple Operation Frame

4.4 The Timing Updating Module

In order to guarantee that the client can inquire the accurate weather information, this design sets two times every day to connect to the network to update. The flow chart of updating module is shown in Fig. 6.

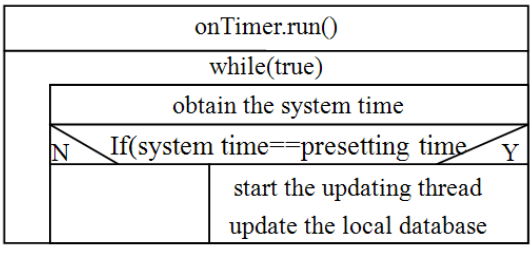

Fig. 6. The flow chart of timing updating module

4.5 The System Realization

The main class TQ is designed in the server-side, it initializes the various components, and is responsible for displaying interface, starting each thread, is the main body of the program. The running interface of Network information query system server is as shown in Fig. 7. Programs can be divided into three display sections: a command bar(the user input some commands to manage the information), an information tooltip window(display the state and all operating information of the server-side) and an simple browser. The browser can display web pages when the web site is inputted in the

Fig. 7. The running interface of Network information query system server

command bar, it will display weather information when meteorological inquires is executed in the server. The realization of the weather information query is as follow: after the server receives the query request of the client it obtains the address information of the query request, then using this address by connecting to the local database it obtains the information then returns to the client.

5 Conclusions

This article designs and implements the mobile query system using the MIDP technology, the background connects to the SQL Server database using JDBC API. The client can easily query weather information by updating the database in time. It's convenient for people to travel. The system has very important practical significance, it can solve the weather information query problem, it can provide the mobile network users for information services, it can meet the information needs of today's society. From the operator's perspective, this system can develop the value-added services, stimulate the user to use the mobile network services to create directly enterprise benefits and create indirectly social value.

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Fuzzy Zero Operator, Fuzzy Q Operator and Its Properties*

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Abstract. There is a lot of discussion about the fuzzy operators located outside Zadeh operators, but there is little discussion about the fuzzy operators located within Zadeh operators. This article first constructed fuzzy zero operators located within Zadeh operators. Second, the article constructed fuzzy Q operators located within Zadeh operators. Finally, this article proved that fuzzy zero operators are the boundary operator located within Zadeh operators and fuzzy Q operators are a new class of continuous fuzzy operators located within Zadeh operators. Through the introduction of fuzzy zero operators and fuzzy Q operators, it added computing tools for treatment of fuzzy phenomenon, at the same time it enriched the theory of fuzzy operators.

Keywords: Operator, Fuzzy operators, Fuzzy zero operator, Fuzzy Q operator.

1 Introduction

Since Zadeh established fuzzy set theorem in 1965, he introduced a pair of fuzzy operators. They are named Zadeh operators[1]. There is a lot of discussion about the fuzzy operators located outside Zadeh operators[2,3,4,5,6], but there is little discussion about the fuzzy operators located within Zadeh operators. By analyzing relation between Zadeh operator and three common generalized operators (Probability operators, Boundary operators and infinite operators), this paper discussed membership relation in Zadeh operator and three generalized operator in common use, and constructed fuzzy zero operators and fuzzy Q operators located within Zadeh operators.

2 Zadeh Operators, Probability Operators, Boundary Operators, Infinite Operators and the Relation between Them

In order to discuss fuzzy operators located within Zadeh operators, it is necessary to introduce the concept of generalized operators. Generalized operators[4] are widely-used operators in fuzzy sets. The definition of Zadeh operators and the definitions of

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three generalized operators in common use (Probability product & probability sum operator, Boundary product & boundary sum operator, Infinite product & infinite sum operator) are as follows.

A. Zadeh operator $(\cap,\cup)$

To any fuzzy set $\tilde{A},\tilde{B},\tilde{C}\in P(U)$, fuzzy set $\tilde{C}=\tilde{A}\cap\tilde{B}$ be called Intersection of fuzzy set $\tilde{A}$ and fuzzy set $\tilde{B}$ if $\forall u\in U$, there is

$$\tilde{C}(u)=(\tilde{A}\cap\tilde{B})(u)=\tilde{A}(u)\wedge\tilde{B}(u);$$

Fuzzy set $\tilde{C}=\tilde{A}\cup\tilde{B}$ be called Union of fuzzy set $\tilde{A}$ and fuzzy set $\tilde{B}$, if $\forall u\in U$, there is

$$\tilde{C}(u)=(\tilde{A}\cup\tilde{B})(u)=\tilde{A}(u)\vee\tilde{B}(u).$$

B. Probability product & probability sum operator $(\hat{\bullet},\hat{+})$

To any fuzzy set $\tilde{A},\tilde{B},\tilde{C}\in P(U)$, fuzzy set $\tilde{C}=\tilde{A}\ \hat{\bullet}\ \tilde{B}$ be called probability product of fuzzy set $\tilde{A}$ and fuzzy set $\tilde{B}$, if $\forall u\in U$, there is

$$\tilde{C}(u)=(\tilde{A}\hat{\bullet}\tilde{B})(u)=\tilde{A}(u)\tilde{B}(u);$$

Fuzzy set $\tilde{C}=\tilde{A}\ \hat{+}\ \tilde{B}$ be called probability sum of fuzzy set $\tilde{A}$ and fuzzy set $\tilde{B}$, if $\forall u\in U$, there is

$$\tilde{C}(u)=(\tilde{A}\hat{+}\tilde{B})(u)=\tilde{A}(u)+\tilde{B}(u)-\tilde{A}(u)\tilde{B}(u).$$

C. Boundary product & boundary sum operator $(\otimes,\oplus)$

To any fuzzy set $\tilde{A},\tilde{B},\tilde{C}\in P(U)$, fuzzy set $\tilde{C}=\tilde{A}\otimes\tilde{B}$ be called boundary product of Fuzzy set $\tilde{A}$ and fuzzy set $\tilde{B}$, if $\forall u\in U$, there is

$$\tilde{C}(u)=(\tilde{A}\otimes\tilde{B})(u)=\max[0,\tilde{A}(u)+\tilde{B}(u)-1];$$

Fuzzy set $\tilde{C}=\tilde{A}\oplus\tilde{B}$ be called boundary sum of fuzzy set $\tilde{A}$ and fuzzy set $\tilde{B}$, if $\forall u\in U$, there is

$$\tilde{C}(u)=(\tilde{A}\oplus\tilde{B})(u)=\min[1,\tilde{A}(u)+\tilde{B}(u)].$$

D. Infinite product & infinite sum operator $(\hat{\infty},\breve{\infty})$

To any fuzzy set $\tilde{A},\tilde{B},\tilde{C}\in P(U)$, fuzzy set $\tilde{C}=\tilde{A}\ \hat{\infty}\ \tilde{B}$ be called infinite product of fuzzy set $\tilde{A}$ and fuzzy set $\tilde{B}$, if $\forall u\in U$, there is

$$\tilde{C}(u)=(\tilde{A}\hat{\infty}\tilde{B})(u)=\begin{cases}\tilde{A}(u) & \tilde{B}(u)=1\\ \tilde{B}(u) & \tilde{A}(u)=1\\ 0 & other\end{cases}$$

Fuzzy set $\tilde{C} = \tilde{A} \breve{\infty} \tilde{B}$ be called infinite sum of fuzzy set $\tilde{A}$ and fuzzy set $\tilde{B}$, if $\forall u \in U$, there is

$$\tilde{C}(u) = (\tilde{A} \breve{\infty} \tilde{B})(u) = \begin{cases} \tilde{A}(u) & \tilde{B}(u) = 0 \\ \tilde{B}(u) & \tilde{A}(u) = 0 \\ 1 & other \end{cases}$$

Zadeh operator and the definitions of three generalized operator in common use (Probability product & probability sum operator, Boundary product & boundary sum operator,Infinite product & infinite sum operator) are discussed[7].

To any fuzzy set $\tilde{A}, \tilde{B} \in P(U)$, Zadeh operator and three other common generalized operators (probability operators, boundary operators and infinite operators) have relation[7]:

$$\begin{aligned} &\tilde{A} \hat{\infty} \tilde{B} \subseteq \tilde{A} \otimes \tilde{B} \subseteq \tilde{A} \hat{\bullet} \tilde{B} \subseteq \tilde{A} \cap \tilde{B} \\ &\subseteq \tilde{A} \cup \tilde{B} \subseteq \tilde{A} \hat{+} \tilde{B} \subseteq \tilde{A} \oplus \tilde{B} \subseteq \tilde{A} \breve{\infty} \tilde{B} \end{aligned} \tag{1}$$

But the fuzzy operators located within Zadeh operators have a little discussion. This paper enriched the theory of fuzzy operators through the introduction of fuzzy zero operators and fuzzy Q operators.

3 Defineition of Fuzzy Zero Operators

From the relation (1) can guess there exists a pair of operators, to any fuzzy set $\tilde{A}, \tilde{B} \in P(U)$, product operation will coincide with sum operation. Note the following calculation.

For Zadeh operator $(\cap, \cup)$

$$\begin{aligned} &\frac{(\tilde{A} \cap \tilde{B})(u) + (\tilde{A} \cup \tilde{B})(u)}{2} \\ &= \frac{[\tilde{A}(u) \wedge \tilde{B}(u)] + [\tilde{A}(u) \vee \tilde{B}(u)]}{2} \\ &= \frac{\tilde{A}(u) + \tilde{B}(u)}{2} \end{aligned}$$

For Probability product & probability sum operator ($\hat{\bullet}, \hat{+}$)

$$\frac{(\tilde{A} \hat{\bullet} \tilde{B})(u) + (\tilde{A} \hat{+} \tilde{B})(u)}{2}$$
$$= \frac{\tilde{A}(u)\tilde{B}(u) + [\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u)]}{2}$$
$$= \frac{\tilde{A}(u) + \tilde{B}(u)}{2}$$

For Boundary product & boundary sum operator ($\otimes$,$\oplus$)

$$\frac{(\tilde{A} \otimes \tilde{B})(u) + (\tilde{A} \oplus \tilde{B})(u)}{2}$$
$$= \frac{\min[1, \tilde{A}(u) + \tilde{B}(u)] + \max[0, \tilde{A}(u) + \tilde{B}(u) - 1]}{2}$$
$$= \begin{cases} \dfrac{\tilde{A}(u) + \tilde{B}(u) + 0}{2} & \tilde{A}(u) + \tilde{B}(u) < 1 \\ \dfrac{1 + \tilde{A}(u) + \tilde{B}(u) - 1}{2} & \tilde{A}(u) + \tilde{B}(u) \geq 1 \end{cases}$$
$$= \frac{\tilde{A}(u) + \tilde{B}(u)}{2}$$

For Infinite product & infinite sum operator ($\hat{\infty}, \breve{\infty}$):

$$\frac{(\tilde{A} \hat{\infty} \tilde{B})(u) + (\tilde{A} \breve{\infty} \tilde{B})(u)}{2}$$
$$= \begin{cases} \dfrac{\tilde{B}(u) + 1}{2} & \tilde{A}(u) = 1 \\ \dfrac{\tilde{A}(u) + 1}{2} & \tilde{B}(u) = 1 \\ \dfrac{0 + \tilde{B}(u)}{2} & \tilde{A}(u) = 0 \\ \dfrac{0 + \tilde{A}(u)}{2} & \tilde{B}(u) = 0 \end{cases}$$
$$= \frac{\tilde{A}(u) + \tilde{B}(u)}{2}$$

So for any fuzzy set $\tilde{A}, \tilde{B} \in P(U)$, calculated in accordance with the method above values is

$$\frac{\tilde{A}(u)+\tilde{B}(u)}{2}.$$

It tips that product operation will coincide with sum operation in the center of formula (1). We introduce a pair of operators in inner of Zadeh operator. They are named zero operators,whose definition are as follows .

Zero product and Zero sum operators $(\hat{0},\breve{0})$

$\forall \tilde{A},\tilde{B},\tilde{C}\in P(U),\forall u\in U$,Zero product $\tilde{C}$ of $\tilde{A}$ and $\tilde{B}$,denoted $\tilde{C}=\tilde{A}\ \hat{0}\ \tilde{B}$, is defined by

$$\tilde{C}(u)=(\tilde{A}\hat{0}\tilde{B})(u)=\frac{\tilde{A}(u)+\tilde{B}(u)}{2} \tag{2}$$

$\forall \tilde{A},\tilde{B},\tilde{C}\in P(U),\forall u\in U$,Zero sum $\tilde{C}$ of $\tilde{A}$ and $\tilde{B}$,denoted $\tilde{C}=\tilde{A}\ \breve{0}\ \tilde{B}$, is defined by

$$\tilde{C}(u)=(\tilde{A}\breve{0}\tilde{B})(u)=\frac{\tilde{A}(u)+\tilde{B}(u)}{2} \tag{3}$$

To zero operator as the boundary, they must have infinitely operators between Zadeh operator($\cap$,$\cup$).

4 Defineition of Q Operators

A new class of continuous fuzzy operators located within Zadeh operators, is called Q operator. The defineition is as follows:

Q product and Q sum operators $(\hat{Q},\breve{Q})$

$\forall \tilde{A},\tilde{B},\tilde{C}\in P(U),\forall u\in U$,Zero product $\tilde{C}$ of $\tilde{A}$ and $\tilde{B}$,denoted $\tilde{C}=\tilde{A}\ \hat{Q}\ \tilde{B}$, is defined by

$$\begin{aligned}\tilde{C}(u)&=(\tilde{A}\hat{Q}\tilde{B})(u)\\&=\frac{2q+1}{4q+1}[\tilde{A}(u)\wedge\tilde{B}(u)]+\frac{2q}{4q+1}[\tilde{A}(u)\vee\tilde{B}(u)]\end{aligned} \tag{4}$$

$\forall \tilde{A},\tilde{B},\tilde{C}\in P(U),\forall u\in U$,Zero sum $\tilde{C}$ of $\tilde{A}$ and $\tilde{B}$,denoted $\tilde{C}=\tilde{A}\ \breve{Q}\ \tilde{B}$, is defined by

$$\begin{aligned}\tilde{C}(u)&=(\tilde{A}\breve{Q}\tilde{B})(u)\\&=\frac{2q}{4q+1}[\tilde{A}(u)\wedge\tilde{B}(u)]+\frac{2q+1}{4q+1}[\tilde{A}(u)\vee\tilde{B}(u)]\end{aligned} \tag{5}$$

It is easy to verify that Q operators are triangular norm. Discussion of the nature of the operator is as follows.

5 Property of Q Operators

On property of Q operators, it is easy to prove that formula (4) and (5) are monotone functions for variables $\tilde{A}(u)$ or $\tilde{B}(u)$.

We give a new conclusion as follows:

Theorem 1. Formula (4) is monotone increasing function for the parameter q.

Proof. $\forall u \in U, q \in (0,+\infty)$,

$$\begin{aligned}
&\frac{d\tilde{C}(u)}{dq} = \frac{d(\tilde{A}\hat{\mathrm{Q}}\tilde{B})(u)}{dq} \\
&= \frac{-2}{(4q+1)^2}[\tilde{A}(u) \wedge \tilde{B}(u)] + \frac{2}{(4q+1)^2}[\tilde{A}(u) \vee \tilde{B}(u)] \\
&= \frac{2}{(4q+1)^2}\{[\tilde{A}(u) \vee \tilde{B}(u)] - [\tilde{A}(u) \wedge \tilde{B}(u)]\} \\
&\geq 0
\end{aligned}$$

That is $\forall u \in U, q \in (0,+\infty)$, $\tilde{C} = \tilde{A}\ \hat{\mathrm{Q}}\ \tilde{B}$ is monotone increasing function for the parameter q.

Theorem 2. Formula (5) is monotone decreasing function for the parameter q.

Proof. $\forall u \in U, q \in (0,+\infty)$,

$$\begin{aligned}
&\frac{d\tilde{C}(u)}{dq} = \frac{d(\tilde{A}\breve{\mathrm{Q}}\tilde{B})(u)}{dq} \\
&= \frac{2}{(4q+1)^2}[\tilde{A}(u) \wedge \tilde{B}(u)] + \frac{-2}{(4q+1)^2}[\tilde{A}(u) \vee \tilde{B}(u)] \\
&= \frac{2}{(4q+1)^2}\{[\tilde{A}(u) \wedge \tilde{B}(u)] - [\tilde{A}(u) \vee \tilde{B}(u)]\} \\
&\leq 0
\end{aligned}$$

In summary, $\forall u \in U, q \in (0,+\infty)$, $\tilde{C} = \tilde{A}\ \breve{\mathrm{Q}}\ \tilde{B}$ is monotone increasing function for the parameter q.

Theorem 3. $\forall\ \tilde{A}, \tilde{B} \in P(U)$, For the parameter $q \to 0$,Q operators $(\hat{\mathrm{Q}}, \breve{\mathrm{Q}})$ and Zadeh operators $(\wedge, \vee)$ have relation as follows:

$$(\tilde{A}\hat{Q}\tilde{B})_0 = (\tilde{A} \wedge \tilde{B}) \subseteq (\tilde{A} \vee \tilde{B}) = (\tilde{A}\breve{Q}\tilde{B})_0 \tag{6}$$

Proof. Omitted.

Theorem 4. $\forall \tilde{A}, \tilde{B} \in P(U)$, For the parameter $q \to +\infty$, Q operators $(\hat{\mathrm{Q}}, \breve{\mathrm{Q}})$ and zero product and zero sum operators $(\hat{0}, \breve{0})$ have relation as follows:

$$(\tilde{A}\hat{Q}\tilde{B})_{+\infty} = (\tilde{A}\hat{0}\tilde{B}) = (\tilde{A}\breve{0}\tilde{B}) = (\tilde{A}\breve{Q}\tilde{B})_{+\infty} \tag{7}$$

Proof. Omitted.

From theorem 1 to theorem 4 implies that continued Fuzzy operators, Q operations, and Zadeh operations have relation as follows:

$$(\tilde{A} \cap \tilde{B}) \subseteq (\tilde{A}\hat{Q}\tilde{B}) \subseteq (\tilde{A}\breve{Q}\tilde{B}) \subseteq (\tilde{A} \cup \tilde{B}) \tag{8}$$

The formula (4) and the formula (5) has defined infinite fuzzy operators.

It is quite evident that the theorem 1 and the theorem 2 have given a sort of continued fuzzy operators[8,9,10] located within Zadeh operators $(\cap,\cup)$.

6 Conclusion

The zero operators are the boundary operator located within Zadeh operators and Q operators are a new class of continuous fuzzy operators located within Zadeh operators. Through the introduction of zero operators and Q operators, it added computing tools for treatment of fuzzy phenomenon, and at the same time it enriched the theory of fuzzy operator.

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A New Specific Property of Dobois-Prade Operators*

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Abstract. The definition of Dobois-Prade operators is perfected. A new specific property of Dobois-Prade operators is discovered that Dobois-Prade operations are continued fuzzy operators. The relation between Dobois-Prade operators and other Fuzzy operators is analysis. The conclution that Dobois-Prade operations could partly replace other fuzzy operations most in use is given. At the same time the relation beteen Dobois-Prade operations and Zadeh operations is given.

Keywords: Operator, Fuzzy operator, Dobois-Prade operator, continued fuzzy operator.

1 Introduction

Since Zadeh established Fuzzy set theorem in 1965, he introduced a pair of Fuzzy operators. They are named Zadeh operators[1]. There is a lot of discussion about the fuzzy operators[2,3,4,5,6],but there is little discussion about the Dobois-Prade operators. This paper discussed membership relation in Dobois-Prade,Zadeh operator and other generalized operator in common use.

2 Primary Definition of Dobois-Prade Operators

We introduce a pair of important operators, Dobois-Prade operators, whose primary definition are as follows [1].

Definition 2.1. $\forall \tilde{A}, \tilde{B}, \tilde{C} \in P(U), \forall u \in U, \lambda \in [0,1]$

Dobois-Prade product $\tilde{C}$ of $\tilde{A}$ and $\tilde{B}$, denoted $\tilde{C} = \tilde{A} \overset{\bullet}{d} \tilde{B}$, is defined by

$$\tilde{C}(u) = (\tilde{A} \overset{\bullet}{d} \tilde{B})(u) = \frac{\tilde{A}(u)\tilde{B}(u)}{\max\{\lambda, \tilde{A}(u), \tilde{B}(u)\}} \tag{2.1}$$

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Dobois-Prade sum $\widetilde{C}$ of $\widetilde{A}$ and $\widetilde{B}$, denoted $\widetilde{C} = \widetilde{A} \overset{+}{d} \widetilde{B}$, is defined by

$$\widetilde{C}(u) = (\widetilde{A} \overset{+}{d} \widetilde{B})(u) = \frac{\widetilde{A}(u) + \widetilde{B}(u) - \widetilde{A}(u)\widetilde{B}(u) - \min\{1-\lambda, \widetilde{A}(u), \widetilde{B}(u)\}}{\max\{\lambda, 1-\widetilde{A}(u), 1-\widetilde{B}(u)\}} \tag{2.2}$$

The pair of operators $(\overset{\bullet}{d}, \overset{+}{d})$ is called Dobois-Prade operators.

In definition 2.1, the primary definition of Dobois-Prade operations has a defect. When λ=0 and $\widetilde{A}(u) = \widetilde{B}(u) = 0$, the denominate of formula (2.1) is zero.When λ=0 and $\widetilde{A}(u) = \widetilde{B}(u) = 1$, the denominate of formula (2.2) is zero.

3 Remedial Definition of Dobois-Prade Operators

Because that the primary definition of Dobois-Prade operations has a defect. We should give a remedial definition of Dobois-Prade operators. It is as follows.

Definition 3.1. $\forall \widetilde{A}, \widetilde{B}, \widetilde{C} \in P(U), \forall u \in U, \lambda \in [0,1]$

Dobois-Prade product $\widetilde{C}$ of $\widetilde{A}$ and $\widetilde{B}$, denoted $\widetilde{C} = \widetilde{A} \overset{\bullet}{r} \widetilde{B}$, is defined by

$$(\widetilde{A} \overset{\bullet}{d} \widetilde{B})(u) = \begin{cases} 0 & \text{if } \lambda = 0 \text{ and } \widetilde{A}(u) = \widetilde{B}(u) = 0 \\ \dfrac{\widetilde{A}(u)\widetilde{B}(u)}{\max\{\lambda, \widetilde{A}(u), \widetilde{B}(u)\}} & \text{others} \end{cases} \tag{3.1}$$

Dobois-Prade sum $\widetilde{C}$ of $\widetilde{A}$ and $\widetilde{B}$, denoted $\widetilde{C} = \widetilde{A} \overset{+}{r} \widetilde{B}$, is defined by

$$(\widetilde{A} \overset{+}{d} \widetilde{B})(u) = \begin{cases} 1 & \text{if } \lambda = 0 \text{ and } \widetilde{A}(u) = \widetilde{B}(u) = 1 \\ \dfrac{\widetilde{A}(u) + \widetilde{B}(u) - \widetilde{A}(u)\widetilde{B}(u) - \min\{1-\lambda, \widetilde{A}(u), \widetilde{B}(u)\}}{\max\{\lambda, 1-\widetilde{A}(u), 1-\widetilde{B}(u)\}} & \text{others} \end{cases} \tag{3.2}$$

4 A New Important Specific Property of Dobois-Prade Operators

On property of Dobois-Prade operators, the paper [1] has proved that formula (2.1) and (2.2) are monotone functions for variables $\widetilde{A}(u)$ or $\widetilde{B}(u)$.

But a new important specific important property of Dobois-Prade operators has not mentioned up to now.

We give a new conclusion as follows:

Theorem 4.1. Formula (3.1) is monotone decreasing function for the parameter λ.

Proof. $\forall u \in U$,

(a) If $\lambda \le \max\{\tilde{A}(u), \tilde{B}(u)\}$ then

$$(\tilde{A} \overset{\bullet}{d} \tilde{B})(u) = \frac{\tilde{A}(u)\tilde{B}(u)}{\max\{\lambda, \tilde{A}(u), \tilde{B}(u)\}}$$

$$= \frac{\tilde{A}(u)\tilde{B}(u)}{\max\{\tilde{A}(u), \tilde{B}(u)\}}$$

$$= \begin{cases} \tilde{B}(u) & \tilde{A}(u) \ge \tilde{B}(u) \\ \tilde{A}(u) & \tilde{A}(u) < \tilde{B}(u) \end{cases}$$

$$= \tilde{A}(u) \wedge \tilde{B}(u)$$

(b) If $\lambda \ge \max\{\tilde{A}(u), \tilde{B}(u)\}$ then

$$(\tilde{A} \overset{\bullet}{d} \tilde{B})(u) = \frac{\tilde{A}(u)\tilde{B}(u)}{\max\{\lambda, \tilde{A}(u), \tilde{B}(u)\}}$$

$$= \frac{\tilde{A}(u)\tilde{B}(u)}{\lambda}$$

$$\frac{\partial (\tilde{A} \overset{\bullet}{d} \tilde{B})(u)}{\partial \lambda} = \frac{-\tilde{A}(u)\tilde{B}(u)}{\lambda^2} \le 0$$

This means formula (3.1) is monotone decreasing function for the parameter λ.

Theorem 4.2. Formula (3.2) is monotone increasing function for the parameter λ.

Proof. $\forall u \in U$,

(a) If $\lambda \le \max\{1-\tilde{A}(u), 1-\tilde{B}(u)\}$, $\tilde{A}(u) \le \tilde{B}(u)$, then

$$\lambda \le 1-\tilde{A}(u),$$

$$1-\lambda \ge \tilde{A}(u),$$

$$\min\{1-\lambda, \tilde{A}(u), \tilde{B}(u)\} = \tilde{B}(u)$$

$$(\tilde{A} \overset{+}{d} \tilde{B})(u)$$

$$= \frac{\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u) - \min\{1-\lambda, \tilde{A}(u), \tilde{B}(u)\}}{\max\{\lambda, 1-\tilde{A}(u), 1-\tilde{B}(u)\}}$$

$$= \frac{\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u) - \min\{\tilde{A}(u), \tilde{B}(u)\}}{\max\{1-\tilde{A}(u), 1-\tilde{B}(u)\}}$$

$$= \frac{\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u) - \tilde{A}(u)}{1-\tilde{A}(u)}$$

$$= \tilde{B}(u)$$

$$= \tilde{A}(u) \vee \tilde{B}(u)$$

(b) If $\lambda>\max\{1-\tilde{A}(u),1-\tilde{B}(u)\}$, $\tilde{A}(u)\le\tilde{B}(u)$,then

$$\lambda>1-\tilde{A}(u),$$

$$\tilde{A}(u)\ge 1-\lambda,$$

$$\min\{1-\lambda,\tilde{A}(u),\tilde{B}(u)\}=1-\lambda$$

$$(\tilde{A}\overset{+}{d}\tilde{B})(u)$$

$$=\frac{\tilde{A}(u)+\tilde{B}(u)-\tilde{A}(u)\tilde{B}(u)-\min\{1-\lambda,\tilde{A}(u),\tilde{B}(u)\}}{\max\{\lambda,1-\tilde{A}(u),1-\tilde{B}(u)\}}$$

$$=\frac{\tilde{A}(u)+\tilde{B}(u)-\tilde{A}(u)\tilde{B}(u)-(1-\lambda)}{\lambda}$$

$$=\frac{\tilde{A}(u)+\tilde{B}(u)-\tilde{A}(u)\tilde{B}(u)-1}{\lambda}+1$$

$$\frac{\partial(\tilde{A}\overset{+}{d}\tilde{B})(u)}{\partial\lambda}$$

$$=\frac{1-[\tilde{A}(u)+\tilde{B}(u)-\tilde{A}(u)\tilde{B}(u)]}{\lambda^2}$$

$$\ge 0$$

This means formula (3.2) is monotone increasing function for the parameter λ.

The formula (3.1) and the formula (3.2) has defined infinite fuzzy operators.It is quite evident that the theorem 4.1 and the theorem 4.2 have given a sort of continued Fuzzy operators[7,8]. This is a new important property of Dobois-Prade operators.

5 The Relation of Dobois-Prade Operators and Other Fuzzy Operators Most in Use

To any fuzzy set $\tilde{A},\tilde{B}\in P(U)$, Zadeh operator and three other common generalized operators (probability operators, boundary operators and infinite operators) have relation[9,10]:

$$\tilde{A}\hat{\infty}\tilde{B}\subseteq\tilde{A}\otimes\tilde{B}\subseteq\tilde{A}\hat{\bullet}\tilde{B}\subseteq\tilde{A}\cap\tilde{B}$$
$$\subseteq\tilde{A}\cup\tilde{B}\subseteq\tilde{A}\hat{+}\tilde{B}\subseteq\tilde{A}\oplus\tilde{B}\subseteq\tilde{A}\breve{\infty}\tilde{B}$$

For the Dobois-Prade operators $(\overset{\bullet}{d},\overset{+}{d})$,we give a new conclusion as follows:

Theorem 5.1. $\forall\ \tilde{A},\tilde{B}\in P(U)$, For the parameter λ=0,the continued Fuzzy operators,that is, Dobois-Prade operators $(\overset{\bullet}{d},\overset{+}{d})$ and Zadeh operators ($\cap$,$\cup$) have relation as follows:

$$(\tilde{A}\overset{\bullet}{d}\tilde{B})_0=(\tilde{A}\cap\tilde{B})\subseteq(\tilde{A}\cup\tilde{B})=(\tilde{A}\overset{+}{d}\tilde{B})_0 \tag{5.1}$$

Proof. If the parameter λ=0,then $\forall u\in U$, the $\tilde{C}(u)$ in definition 3.1 is denoted $(\tilde{A}\overset{\bullet}{d}\tilde{B})_0$ and $(\tilde{A}\overset{+}{d}\tilde{B})_0$ as follows:

$$(\tilde{A}\overset{\bullet}{d}\tilde{B})_0(u)=\begin{cases}0 & \tilde{A}(u)=\tilde{B}(u)=0\\ \dfrac{\tilde{A}(u)\tilde{B}(u)}{\max\{0,\tilde{A}(u),\tilde{B}(u)\}} & others\end{cases}$$

$$(\tilde{A}\overset{+}{d}\tilde{B})_0(u)=\begin{cases}1 & \tilde{A}(u)=\tilde{B}(u)=1\\ \dfrac{\tilde{A}(u)+\tilde{B}(u)-\tilde{A}(u)\tilde{B}(u)-\min\{1-0,\tilde{A}(u),\tilde{B}(u)\}}{\max\{0,1-\tilde{A}(u),1-\tilde{B}(u)\}} & others\end{cases}$$

Zadeh operators are denoted by

$$(\tilde{A}\cap\tilde{B})(u)=\tilde{A}(u)\wedge\tilde{B}(u)$$
$$(\tilde{A}\cup\tilde{B})(u)=\tilde{A}(u)\vee\tilde{B}(u)$$

If $\tilde{A}(u)=\tilde{B}(u)$=0 then

$$(\tilde{A}\overset{\bullet}{d}\tilde{B})_0(u)=0=(\tilde{A}\cap\tilde{B})(u);$$

If $\tilde{A}(u)$=0 or $\tilde{B}(u)$=0 then

$$(\tilde{A}\overset{\bullet}{d}\tilde{B})_0(u)=\frac{\tilde{A}(u)\tilde{B}(u)}{\max\{0,\tilde{A}(u),\tilde{B}(u)\}}=0$$
$$=(\tilde{A}\cap\tilde{B})(u);$$

If $\tilde{A}(u)\neq0$ and $\tilde{B}(u)\neq0$, we subdivide proof into two steps:

(*a*) Let $\tilde{A}(u)\geq\tilde{B}(u)$, then

$$(\tilde{A}\overset{\bullet}{d}\tilde{B})_0(u)=\frac{\tilde{A}(u)\tilde{B}(u)}{\max\{0,\tilde{A}(u),\tilde{B}(u)\}}$$
$$=\frac{\tilde{A}(u)\tilde{B}(u)}{\tilde{A}(u)}$$
$$=\tilde{B}(u)$$
$$=(\tilde{A}\cap\tilde{B})(u)$$

(*b*) Let $\tilde{A}(u) < \tilde{B}(u)$, then

$$(\tilde{A} \overset{\bullet}{d} \tilde{B})_0(u) = \frac{\tilde{A}(u)\tilde{B}(u)}{\max\{0, \tilde{A}(u), \tilde{B}(u)\}}$$

$$= \frac{\tilde{A}(u)\tilde{B}(u)}{\tilde{B}(u)}$$

$$= \tilde{A}(u)$$

$$= (\tilde{A} \cap \tilde{B})(u)$$

If $\tilde{A}(u) = \tilde{B}(u) = 1$ then

$$(\tilde{A} \overset{+}{d} \tilde{B})_0(u) = (\tilde{A} \cup \tilde{B})(u) = 1;$$

If $\tilde{A}(u)$ and $\tilde{B}(u)$ are not simultaneously equal to 1,we subdivide proof into two steps:

(*a*) Let $\tilde{A}(u) \geq \tilde{B}(u)$, then

$$(\tilde{A} \overset{+}{d} \tilde{B})_0(u)$$

$$= \frac{\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u) - \min\{1, \tilde{A}(u), \tilde{B}(u)\}}{\max\{1 - \tilde{A}(u), 1 - \tilde{B}(u)\}}$$

$$= \frac{\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u) - \tilde{B}(u)}{1 - \tilde{B}(u)}$$

$$= \tilde{A}(u)$$

$$= (\tilde{A} \cup \tilde{B})(u)$$

(*b*) Let $\tilde{A}(u) < \tilde{B}(u)$, then

$$(\tilde{A} \overset{+}{d} \tilde{B})_0(u)$$

$$= \frac{\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u) - \min\{1, \tilde{A}(u), \tilde{B}(u)\}}{\max\{1 - \tilde{A}(u), 1 - \tilde{B}(u)\}}$$

$$= \frac{\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u) - \tilde{A}(u)}{1 - \tilde{A}(u)}$$

$$= \tilde{B}(u)$$

$$= (\tilde{A} \cup \tilde{B})(u)$$

It is quite evident that (*a*) and (*b*) implies (5.1).

Theorem 5.2. $\forall \tilde{A}, \tilde{B} \in P(U)$, For the parameter λ=1, continued Fuzzy operators, that is, Dobois-Prade operators $(\overset{\bullet}{d}, \overset{+}{d})$ and probability sum and probability product operators $(\hat{\bullet}, \hat{+})$ have relation as follows:

$$(\tilde{A} \overset{\bullet}{d} \tilde{B})_1 = (\tilde{A} \hat{\bullet} \tilde{B}) \subseteq (\tilde{A} \hat{+} \tilde{B}) = (\tilde{A} \overset{+}{d} \tilde{B})_1 \tag{5.2}$$

Proof. If λ=1, the $\tilde{C}(u)$ in the definition 3.1 is denoted $(\tilde{A} \overset{\bullet}{d} \tilde{B})_1$ and $(\tilde{A} \overset{+}{d} \tilde{B})_1$,we have

$$(\tilde{A} \overset{\bullet}{d} \tilde{B})_1(u) = \frac{\tilde{A}(u)\tilde{B}(u)}{\max\{1, \tilde{A}(u), \tilde{B}(u)\}}$$

$$= \tilde{A}(u)\tilde{B}(u)$$

$$= (\tilde{A} \hat{\bullet} \tilde{B})(u)$$

$$(\tilde{A} \overset{+}{d} \tilde{B})_1(u)$$

$$= \frac{\tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u) - \min\{0, \tilde{A}(u), \tilde{B}(u)\}}{\max\{1,1-\tilde{A}(u),1-\tilde{B}(u)\}}$$

$$= \tilde{A}(u) + \tilde{B}(u) - \tilde{A}(u)\tilde{B}(u)$$

$$= (\tilde{A} \hat{+} \tilde{B})(u)$$

This implies (5.2).

From theorem 4.1 to theorem 5.2 implies that continued Fuzzy operators, Dobois-Prade operations, and Zadeh operations have relation as follows:

$$(\tilde{A} \overset{\bullet}{d} \tilde{B}) \subseteq (\tilde{A} \cap \tilde{B}) \subseteq (\tilde{A} \cup \tilde{B}) \subseteq (\tilde{A} \overset{+}{d} \tilde{B}) \tag{5.3}$$

6 Conclusion

From theorem 4.1 to theorem 5.2 implies that Dobois-Prade operations is continued Fuzzy operators and that Dobois-Prade operations could partly replace other fuzzy operations most in use.

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Simulation Environment Realization for Vehicular Ad Hoc Network Based on NS2*

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Abstract. In the current market, there was only specific software for network simulation or traffic simulation. They were expensive and could not support the simulation for vehicular Ad Hoc network. In order to solve the problem, simulation environment for vehicular Ad Hoc network based on free network simulation software NS2 was realized. The simulation environment was mainly realized based on the second development of NS2 software. The obstacle model and node mobile model were added. The nodes could not communicate when they were blocked by the obstacles. The nodes moved in random speed and direction on the road. Simulation results show that the simulation environment works well in the NS2 software. It is a helpful cornerstone for further research on some algorithms of vehicle Ad Hoc networks.

Keywords: vehicular Ad Hoc network, obstacle model, node mobile model, NS2 simulation.

1 Introduction

With the rapid development of society, modern cities are expanding, and traffic demand is increasing. Road traffic negative phenomenon such as jam, congestion and frequent accidents become more prominent. Road traffic has become the bottleneck of cities development and gradually been a global common problem in economic and social development.

To solve the problems such as traffic safety and high efficiency, inter-vehicle communication (IVC) and road-vehicle communication (RVC) are necessary to automatically set up temporary, self-organizational and fast mutative wireless vehicular ad hoc network (VANET). In the VANET, the real-time inter-vehicle and road-vehicle communications are realized. They can meet traffic information sharing in multi-aspects and inter-vehicle communication needs. The VANET can be ease to extend the driver's vision, get traffic real-time information, and coordinate the vehicle

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traffic. With interconnection between VANET and internet, the VANET also enables automatic charging, vehicle tracking, illegal records and so on [1]. VANET is an important part of intelligent transportation system. It has become a hot research technology all over the world, and attracts great academic attention [2] [3].

In the VANET, a realistic mobility model is not only very important for getting accurate results in routing performance evaluation but also a necessary component to predict the next positions of vehicles and make smarter route decisions [4]. Random way point (RWP) mobility model is one of the simplest and the earliest mobility model [5], where nodes randomly choose a destination and continue to move toward that destination at a uniform speed. The reference [6] first attempted to propose a realistic street mobility model. The reference [7] used a set of movement traces derived from typical situations on German Autobahns to simulate the traffic movement on a highway. The reference [8] uses CORSIM, a proprietary vehicular traffic simulator to provide mobility traces for the simulation. The reference [9] proposed a new mobility model call STRAW which incorporates a simple car-following model with traffic on troll to introduce vehicular congestion, which models real traffic conditions. Also there is another trend toward coupling between network simulators (e.g., NS, GloMoSim) with vehicle traffic simulators (e.g., CORSIM, VISSIM). So co-simulation of network traffic and vehicle traffic can be conducted [10]. Another advantage of this approach is that the effects of diver behavior can be simulated [11]. But much software such as CORSIM, VISSIM and GloMoSim are expensive and not specific to the simulation of vehicle network. It still needs co-simulation. Therefore, the simulation environment for VANET is researched based on free software NS2. The obstacle model and node mobile model are added to construct the environment.

2 Obstacle Model

A. Definition of Obstacle

In NS2, there is no obstacle object. So the object needs its own definition. Assume the vehicles are at the same level. Then the third dimension height of obstacle object is infinite. The obstacle model is simplified to two-dimensional line in the plane. The line is determined by the location of two endpoints. Obstacle is expressed as $\{P_1(x_1, y_1), P_2(x_2, y_2)\}$. Assume that obstacles exist in the whole simulation process, and do not change in location and other attributes. Typical obstacles are walls, buildings, hills and so on. Wall can be represented by an obstacle object, namely a straight line segment. Buildings and hills are represented by a closed line segment group. The group contains a set of line segments which connect end to end [12].

Assume that all nodes use omni-directional antenna. Obstacles block the transmission radio waves and radio shadow area is generated. When line segment of two wireless nodes has intersection with obstacles, transmission radio wave is completely absorbed. Therefore, the communication fails.

B. Node Blocked Algorithm

The existence of obstacles between two mobile nodes is judged by the calculation whether two line segments intersect. So it can be solved with plane analytic geometry in math.

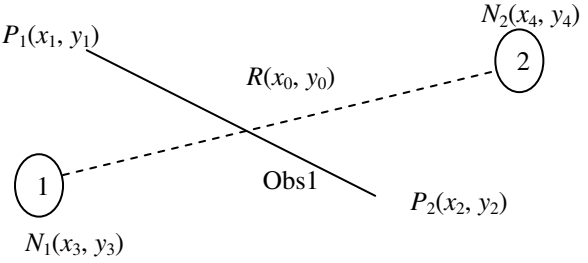

Fig. 1. Judge whether nodes are blocked

As is shown in fig.1, Obs1:{ $P_1(x_1, y_1)$, $P_2(x_2, y_2)$} is an obstacle. The locations of two mobile nodes are $N_1(x_3, y_3)$ and $N_2(x_4, y_4)$. Intersection of the two lines is $R(x_0, y_0)$. It can be divided into the following five cases [12].

Case 1: $x_1=x_2$, and $x_3=x_4$.Then two straight lines parallel or overlap, namely no intersection.

Case 2: $x_1=x_2$, and $x_3\neq x_4$.

$$x_0=x_1. \tag{1}$$

$$y_0 = \frac{(y_4 - y_3)(x_1 - x_3)}{x_4 - x_3} + y_3 . \tag{2}$$

Case 3: $x_3=x_4$, and $x_1\neq x_2$.

$$x_0=x_3. \tag{3}$$

$$y_0 = \frac{(y_2 - y_1)(x_3 - x_1)}{x_2 - x_1} + y_1 . \tag{4}$$

Case 4: $x_1\neq x_2$, $x_3\neq x_4$, and $\frac{y_2 - y_1}{x_2 - x_1} = \frac{y_4 - y_3}{x_4 - x_3}$. Then the two straight lines parallel or overlap, namely no intersection.

Case 5：other cases

$$x_0 = \frac{(x_4 - x_3)(y_2 - y_1)x_1 - (x_2 - x_1)(y_4 - y_3)x_3 + (y_3 - y_1)(x_2 - x_1)(x_4 - x_3)}{(x_4 - x_3)(y_2 - y_1) - (x_2 - x_1)(y_4 - y_3)} \tag{5}$$

$$y_0 = \frac{(x_4 - x_3)(y_2 - y_1)y_3 - (x_2 - x_1)(y_4 - y_3)y_1 + (x_1 - x_3)(y_2 - y_1)(y_4 - y_3)}{(x_4 - x_3)(y_2 - y_1) - (x_2 - x_1)(y_4 - y_3)} \tag{6}$$

If the intersection $R(x_0,y_0)$ satisfies the conditions: $\min\{x_1,x_2\}\leq x_0\leq\max\{x_1,x_2\}$, $\min\{x_3,x_4\}\leq x_0\leq\max\{x_3,x_4\}$, $\min\{y_1,y_2\}\leq y_0\leq\max\{y_1,y_2\}$, and $\min\{y_3,y_4\}\leq y_0\leq\max\{y_3,y_4\}$, then the intersection exists, and nodes are blocked. Otherwise, the intersection is on the extension line of two line segments. Nodes are not blocked. So communication can work.

C. Design Ideas of Obstacle Model

Step 1: Add obstacle class inheriting TCLObject class in NS2.

Step 2: Define blocked function realizing the node blocked algorithm.

Step 3: Modify the Mac802_11::recv function.

Remarks

- The members of added obstacle class are divided into three parts: location information of obstacles such as P1_X, Get_P1_X, all obstacle link lists, and some public interfaces.
- Obstacle positions and physical positions of both receiver and transmitter are considered. Blocked function is used to find out whether the communication of nodes is blocked by obstacles.
- Received function Mac802_11::recv is modified in mac-802_11.cc. Data packet is analyzed. Mac addresses of both transmitter and receiver are read. By the transfer function, physical addresses are gotten. Then all obstacle physical addresses are read through the obstacle link list. Whether one obstacle blocks the current receiver and transmitter is judged. If it does, discard the packet, and end received function, else continue another obstacle. If no block occurs, continue to execute the original code in NS2.

3 Node Mobile Model

When obstacle model is accomplished, it is necessary to add node mobile mode. NS2 software provides setdest tool. Setdest is a tool provided by CMU University. The tool randomly generates node mobile scene needed in wireless network simulation. Namely, in a fixed rectangular area a certain number of nodes move toward random destination. When they arrive, it stays for some time (or not). Then they move toward another random destination in random speed. However, it cannot meet the requirement of VANET. Therefore, it is necessary to modify setdest tool.

A. Modification Idea of Node Mobile Model

According to setdest program, main modification steps are as follows:

Step 1: Add related obstacle variables. They include obstacle structure such as ObstacleEntry, ObstacleBox and initialization of related parameters such as RoadWidth, DistanceToBoxBound.

Step 2: Add functions for processing the obstacle coordinate such as ObstaclePoint_maxx, ObstaclePointEqua, SetBox.

Step 3: Add CrossType and PointDirOfBox functions.

Step 4: Modify Node::RandomPosition() functions and Node::RandomDestination() functions.

Step 5: Make the modified setdest program and call ./setdest in cygwin to generate node mobile model file.

Remarks

- It is necessary to set obstacle coordinate in setdest. Therefore, related obstacle structures are added to contain obstacle coordinate. Also, it is necessary to set

related parameters such as obstacle number, road width, the distance between vehicles and roadside, the intersection distance and so on.

- Input obstacle coordinates. A series functions used to process obstacle coordinates are added. The function ObstaclePoint_maxx is used to get the maximum horizontal coordinate. The function ObstaclePointEqual is used to judge whether the two obstacles have the same coordinates. The function SetBox is used to judge whether multiply obstacles can form a closed line.
- The function PointDirOfBox is used to judge relationship between node coordinate and obstacle location. It returns specific information about node location. The function CrossType is used to judge node possible movement direction when node moves to vertex of obstacles such as intersection.
- According to above variables and functions, Node::RandomPosition() is modified to randomly initialize the node location on the roads. Node::RandomDestination() is modify to generate the random moving direction and speed for nodes. When node moves to intersection, randomly choose another road and move on.

4 Second Development of Nam

The added obstacle model and node mobile model needs to show on Nam. To represent obstacles intuitively with graphics, Nam file format is secondly developed to recognize and show obstacles [12].

Step 1: define a string format (O -t -X -Y -x –y) for obstacles.

Step 2: define obstacle class and add ObstacleEvent.

Step 3: call draw function in obstacle class, according to the values x_1, y_1, x_2, and y_2.

Remarks

- A string format (O -t -X -Y -x –y) for obstacle is defined. All parameters are double type. O represents obstacle. Time value follows –t. x_1 follows –X. y_1 follows –Y. x_2 follows –x. y_2 follows -y. "O -t 0.0 -X 20.0 -Y 0.0 -x 100.0 -y 0.0" is an example.
- Obstacle structure added into ParseTable is defined. Obstacle is added into link table of drawing objects (drawables). Draw functions in obstacle class is realized.
- Obstacles are shown on the Nam.

5 Simulation and Results

A. Experiment Assumption

- Node moves randomly on the same level without considering on the different level.
- Obstacles can block the transmission radio. While transmission radio is completely absorbed, the nodes can not communication. Does not consider radio diffraction.

- Nodes have the same performance (such as radio transmission power, communication radius);
- Nodes periodically transmit data. They transmit to destination node directly or in multi-hop way.

B. Experimental Basis

As is shown in table 1, there are simulation parameters in NS2. 40 wireless nodes are randomly generated in the 500m*500m range. Set the wireless node's antenna, physical layer, link layer, routing layer, queue, business and other parameters before simulation. Node can move in random direction and speed on the road around obstacles.

Table 1. Simulation parameter table

Parameter	Value	Parameter	Value
Scene/m^2	500*500m	MAC layer	IEEE802.11
Number of nodes	40	Queue type	PriQueue
Simulation time	500s	Antenna type	OmniAntenna
Channel type	wireless channel	Queue length	50
Transmission path	TwoRay ground	Routing protocol	AODV
Logical link layer	LL	Business class	CBR

C. Analysis of Simulation Results

As shown in fig.2, there is no obstacle between node 31 and node 17. Therefore they can communication with each other. On the other side, node 31 and node 9 are blocked by obstacle. They can not communication. Therefore they can not transmit and receive data with each other.

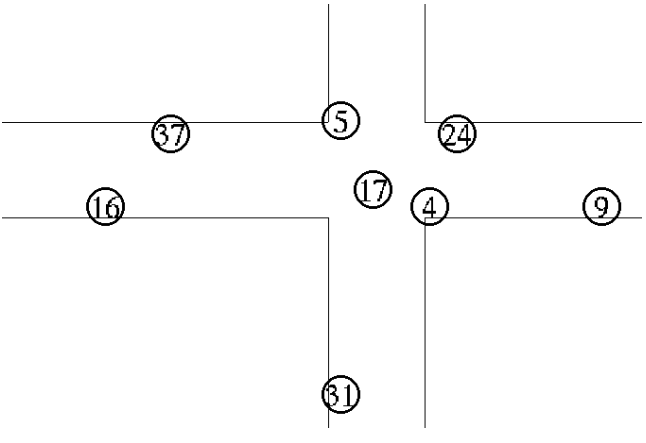

Fig. 2. Crossroad

As shown in fig.3, the simulation scene has 500*500m range. In the scene, there are one 80*460 building and one 330*460 building. They consist of the obstacles. All 40 nodes follow their own moving path and move randomly.

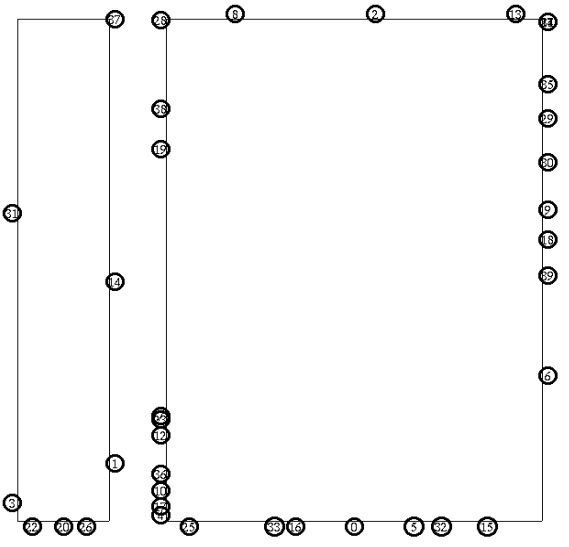

Fig. 3. Simulation environment of two buildings

As shown in fig.4, the simulation scene has 500*500m range. In the scene, there are four 220*220 buildings. All 40 nodes follow their own moving path and move randomly.

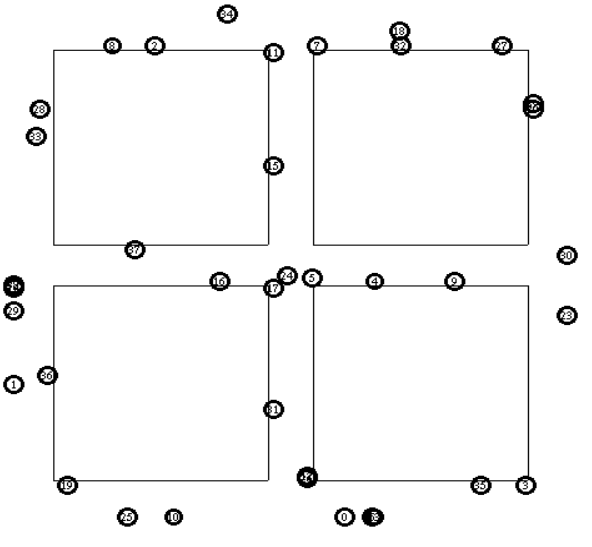

Fig. 4. Simulation environment of four buildings

Therefore, the simulation environment for VANET is accomplished with the obstacle model and node mobile model. In the environment, the nodes move randomly on the road. It provides a beneficial simulation platform for the research on VANET.

6 Conclusion

Because the simulation software for network simulation or traffic simulation is expensive, a method for simulation based on free software NS2 is proposed. In the NS2, the obstacle model and node mobile model are added. Simulation parameters are set. Finally simulation environment is established.

Simulation results show that the nodes can not communication when obstacle blocks them. Simultaneity, nodes can move in random speed and direction on the roads around obstacles. This simulation environment is convenient and a helpful cornerstone for further research on VANET.

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Application of a New Weighted Association Rules Model for Medical Images Data Mining*

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Abstract. This paper combines the two aspects: weighted association rules mining and medical images data, proposing a new weighted association rules model. First this paper define the weighted support of a rule based on the maximal weight, which can reflect the different importance and unbalance of individual items in database and make the item with a heavy weight in an outstanding position. By constructing a new model of mining weighted association rules, this paper discusses the characters of the model and describes the algorithm MWAR accordingly. Then the paper illustrates the medical images data mining process by fact and the experiment results are compared with that of MINWAL(O), they show that MWAR is more efficient and the item sets with the small weight are weighted frequent itemsets and so do the itemsets with the big weight when they have the same frequency. Finally, the paper lists the conclusions and gives suggestions for future work.

Keywords: Weighted association rules, MWAR algorithm, Medical images data, Weighted support.

1 Introduction

With the development of biomedical engineering technology, medical data increased rapidly. How mine the correlative relationship from massive amounts of medical image data is research focus. Currently most researchers concern about the investigation of association rules mining, but neglect the weight of different item, and can not mining weighted association rules in medical image data.

This paper combined two aspects: weighted association rules mining and medical image data, proposing a new weighted association rules model. In section 2, this paper attempts to define the weighted support of a rule based on the maximal weight, and then constructs a new model of mining weighted association rules. Section 3 discusses the characters of the model and describes the algorithm, MWAR (Mining Weighted Association Rules) accordingly. Section 4 illustrates the medical data

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mining process by fact. Finally, Section 5 lists some conclusions and gives suggestions for future work.

2 Weighted Association Rules

Similar to [1], we consider a database as a set of transactions D including a set of items $I=\{i_1,i_2,\ldots,i_m\}$. Each transaction is a subset of I, which is assigned a transaction identifier <TID>.

Definition 1. an association rule has the form of $X\Rightarrow Y$, where $X\subset I$, $Y\subset I$, and $X\cap Y=\varnothing$.

We define the terms of support and the confidence as in [1].

Definition 2. The support of the association rule $X\Rightarrow Y$ is the probability that $X\cup Y$ exist in a transaction in the database D.

Definition 3. The confidence of the association rule $X\Rightarrow Y$ is the probability that Y exists given that a transaction contains X, i.e., Confidence($X\Rightarrow Y$)=

$$\frac{Support\_count(X\cup Y)}{Support\_count(X)}$$

Given a set of items $I=\{i_1,i_2,\ldots,i_m\}$, we assign a weight $w(i_j)$ for each item i_j to show the importance, with $0\le w(i_j)\le 1$,where j=1,2,…,m, which is a quantitative index to measure the profit. The more profit the item gets, the bigger the weight is.

Items from 1 to m in I is ranged in a descending order to construct a linear sets. $\forall x, y\in I$, $x<y$ shows that x precedes y. $\forall X\subset I$, items in X are same to arrangement in I. X(i) presents the item i in X.

Definition 4. We define the weight for the X,

$W(X)=\overset{\vee}{_{x\in X}} w(x)$,where $0\le W(X)\le 1$.

According to Definition 2, we can define the weighted support for the weighted association rules.

Definition 5. The weighted support of a rule $X\Rightarrow Y$ is

$WSupport(X\Rightarrow Y)= W(X\cup Y)\times Support(X\Rightarrow Y)$

Similar to [1], a support threshold and a confidence threshold will be assigned to measure the strength of the association rules.

Definition 6. A k-itemset X is called a small item-set if the weighted support of such itemset is less than the minimum weighted support (wminsup) threshold, or $W(X)\times Support(X) < Wminsup$, Otherwise, X is a large k-itemset.

Definition 7. An association rules $X\Rightarrow Y$ is called an interesting rule if $X\cup Y$ is a large itemset and the confidence, defined in definition 3, of the rule is greater than or equal to a minimum confidence threshold.

3 Mining Weighted Association Rules

A. Weighted Association Rules

The reason why Apriori works is that if an itemset is frequent all the subsets of that itemset must be frequent. However, for the weighted case, the means of frequent itemset needs to be modified to handle weighted support. A new algorithm is needed to solve the mining of the weighted association rules.

The characters of weighted association rules are discussed in the following part:

Theorem 1. Suppose the itemset $X= \{i_1, i2,\ldots,i_k\}$, where $k>1$, $i_1 \in Y \subseteq X$, so

1) $W(X) = W(Y)$;

2) If X is frequent itemset, so does Y.

No proof for Theorem 1 is provided here in light of definition 5.

Definition 8. X and Y is joinable, marked $X \bowtie Y = \{X(1), X(2),\ldots, X(k-1), Y(k-1)\}$, when $X(i)=Y(i)$, $i=1,2,\ldots,k-2$; $X(k-1)<Y(k-1)$ and $k>2$.

Theorem 2. When $k>2$, any weighted frequent k-itemsets can be got through joining two frequent k-1-itemsets together.

Proof : $\forall X$, where $X=\{i_1,i_2,\ldots,i_k\}$, $k>2$, $X \subset L_k$. Suppose $Y=\{i_1,i_2,\ldots,i_{k-1}\}$, $Z=\{i_1,i_2,\ldots,i_{k-2},i_k\}$, in accordance with theorem 1, $Y,Z \in L_{k-1}$, $X = Y \bowtie Z$.

Theorem 3. When $k=1$, $C_1=\{\{x\}|x \in I\}$; when $k=2$, $C_2=\{\{x,y\}|\{x\} \in L_1, y \in I$ and $x<y\}$;when $k>2$, $C_k=\{X \bowtie Y | X \in L_{k-1}, Y \in L_{k-1}$,and X,Y are joinable$\}$.So $\forall k$, $L_k \subseteq C_k$.

Proof is omitted.

B. Algorithms for mining weighted association rules

The algorithm for mining weighted association rules can be established based on the above Definitions and Theorems.

An algorithm for mining weighted association rules has the following inputs and outputs. Notations used in algorithm are listed in table 1.

Inputs: A database D with the transaction T, two threshold value wminsup and minconf, weights of the items w_i, with descending order, total number of transactions and the total number of the item.

Outputs: A list of interesting rules.

Table 1. Notations

D	The database
w	The set of item weights
L_k	Set of large k-itemset
C_k	Set of k-itemsets which may be k-subsets of large j-itemsets for $j \geq k$
wminsup	Weighted support threshold
minconf	Confidence threshold

Algorithm MWAR

(1) C_1=Generate_C_1(D);
(2) L_1={c∈C_1|WSup(c) ≥wminsup};
(3) C_2={{x,y}|x∈L_1,y∈C_1且x<y};
(4) L_2={c∈C_2|WSup(c) ≥wminsup};
(5) For (k=3;L_{k-1}≠∅;k++) {
(6) C_k ={X⋈Y | X∈L_{k-1}, Y∈L_{k-1}; X (i) =Y (i), i=1, 2, …, k-2; X(k-1)<Y(k-1)};
(7) L_k={c∈C_k|WSup(c)≥wminsup};
(8) };
(9) Return L=∪kL_k;
(10) Rules (minconf, L);

Generate_C_1(D) is a function that simply scanning all of the transactions in the database D to generate candidate 1-itemsets.

Rules (minconf, L) can generate weighted association rules that satisfy minimum confidence from L.

C. Relationship between mining weighted association rules and medical images data

By far, there are some matured data mining systems at home and abroad, for instance Quest, MineSet, MSMiner ect[3], but the application of data mining in hospital, especially in medical image systems is very rare. This paper imposes the data mining into medical analyzing, which can find the connotative associations between patient's conditions and illnesses.

Different from the other transaction data, medical image data has its own characters [6]:

1) The cases of illness are dynamic and are updating continually;
2) Generally, the analyses are aim at one kind of illness, not all kinds;
3) The data must be extracted from medial image.

So, the algorithms must adapt to all characters above.

4 The Application of Algorithm MWAR for Medical Image Data Mining

This paper uses the data in [5] and selects 40 cases randomly, constructing the mammography database D, shown as table 2. In table 2, each item have specific medical meaning and is endowed with different weight in accordance with its importance in disease diagnose. I1 means large object size and its weight is 0.95, I2 means lower noise and its weight is 0.9, I3 means higher contrast ratio and its weight is 0.89, I4 means rough texture and its weight is 0.85, I5 means abnormal gray scale and its weight is 0.93.

Table 2. The Mammography Database D

TID	Items	TID	Items	TID	Items	TID	Items
1	I3, I5	11	I2, I3, I5	21	I1, I2, I3	31	I1, I2, I4
2	I2, I3, I4	12	I2, I4	22	I2, I3, I5	32	I1,I2,I4,I5
3	I1, I4	13	I1, I3	23	I2, I3, I5	33	I1, I3
4	I1, I3, I4	14	I1, I2, I3	24	I2, I3	34	I1, I3, I4
5	I1, I2, I3	15	I1, I2, I3	25	I1, I3, I4	35	I2, I3, I4
6	I1, I3, I4	16	I1, I2, I3	26	I1, I2, I3	36	I2, I3, I4
7	I3, I4, I5	17	I1,I2,I3,I4	27	I1, I2, I4	37	I1, I2, I3
8	I1, I4, I5	18	I1, I3, I4	28	I1, I2, I4	38	I1, I4, I5
9	I1, I2, I3	19	I3, I4	29	I1, I5	39	I1, I2, I3
10	I1, I3, I4	20	I1, I2	30	I1, I3, I4	40	I2, I4, I5

From the above tables, we will show how the large itemsets are generated from the transaction database. Suppose the wminsup is 0.1 and minconf is 0.45.

The weighted association rules and frequent item sets are found by Algorithm MWAR, shown as in figure 1. In this figure, in the left textbox the weighted association rules are listed with their configurations; in the right textbox the frequent item sets are listed with their supports and weighted support.

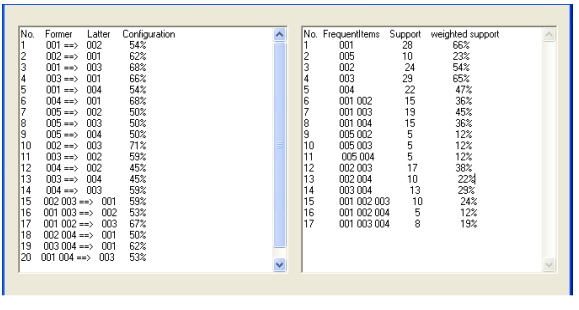

Fig. 1. Weighted association rules and frequent item sets are found by MWAR

We implemented the two algorithms MWAR and MINWAL on an IBM R52 with a 1.73GHz CPU.

The test is based on the synthetic databases, in which 6 values of thresholds (wminsup) are used for each test, namely {0.1, 0.15, 0.2, 0.25, 0.3, 0.35} in the mining weighted association rules.

Figure 2 shows the decreasing trend of the execution time when the weighted support threshold increase. Furthermore, when comparing the two algorithms MWAR and MINWAL in the same wminsup, it is noticed that the time needed for the MWAR is much less than MINWAL. It is because that the weighted frequent itemsets in MWAR is more interesting for decision-makers than in MINWAL. So we can see that MWAR is in general more efficient in mining weighted association rules.

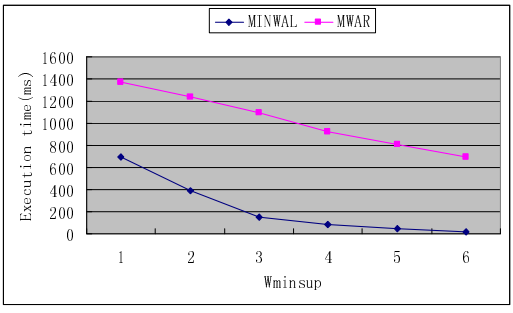

Fig. 2. Execution time for each algorithm

5 Conclusions

Theorem 3 discusses respectively how to get the candidate itemsets 1, 2, 3. Such practice retain the candidate itemsets which belong to weight frequent itemsets but not the subset of other weight frequent itemsets so as to guarantee the correctness of the MWAR algorithm.

The value of weighted support is between 0 and 1 in MWAR.

The result also shows that if the itemsets with the small weight are weighted frequent itemsets, so do the itemsets with the big weight, under the condition of the same frequency. This result seems reasonable and can be of great practical significance to decision-makers.

Notes: suppose that the decision-makers show no interest in items with small weight, they can delete them. The MWAR algorithm can be applied to the renewed database, which can not only reduce work on mining but also find out the decision-makers' interest.

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Thinking about the Expansion of the Training Goal of PE Major under the Stern Employment Situation*

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Abstract. By the methods of literature review, questionnaires, interview, and logical analysis, the author investigated and analyzed the employment whereabouts of the 2011 PE major graduates of 5 normal universities of China, and briefly generalized that the current training goals of PE major, with some certain limitations, cannot fully reflect the actual employment demand of PE major graduates, namely, the diversification of the PE major graduates' employment prospects. On this basis, the author put forward some corresponding solutions, in hope of providing certain reference for implementing and resolving the employment plan of PE majors and propelling the development of the disciplines of Physical Education.

Keywords: Physical Education, training goals, expansion.

Along with the rapid economic development and the continuous social changes, the sports course of China is also constantly developing and changing. Sports are changing from single fitness function to socialization, relevance to daily life, and functionalization of value. In the process of the changes, it proposes new requirements to the university training system undertaking the task of cultivating sports talents. Under the stern employment situation caused by the oversupply of university graduates, the graduates of PE major are also facing difficulties in getting jobs. In order to solve the employment problems, many PE theorists have done researches from various aspects, but few of them analyzed whether the training goals meet the actual needs of the graduates in employment, or whether the graduates trained under the training goals are well positioned to meet the requirements of the society. With the aim of making the training goals to better serve the talent cultivation, the author investigated and analyzed the employment whereabouts of the 2011 PE major graduates from 5 universities, and put forward some approaches and suggestions to expand the training goal, in hope of providing certain reference for implementing and resolving the employment plan of PE majors and propelling the development of the disciplines of Physical Education.

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1 The Research Objects and Methods

The author mainly adopted the methods of literature, questionnaires, interviews, and logical analysis, and used the training goal of PE major of China and the employment whereabouts of 500 PE major graduates of 2011 from South China Normal University, Nanjing Normal University, Fujian Normal University, Huaibei Normal University, and Anhui Normal University as the research objects, and compiled the statistics and make charts for the research results with EXCEL.

2 Results and Analysis

2.1 The Interpretation of the Training Goal

After the start of the large-scale enrollment expansion of colleges and universities in 1999, the situation that a great number of college graduates swarmed into the society increased the severity of competition in employment, and made it difficult for PE major graduates to obtain employment. To alleviate the situation, the Ministry of Education promulgated *The National Undergraduate Curriculum Plan for Physical Education of Regular Institutions of Higher Education* (Jiao Ti Yi [2003] No. 7) [1], revising the training goal of undergraduate physical education to "cultivating the interdisciplinary talents competent for undertaking school physical education, teaching, training, and competition, as well as engaging in sports science research, management of school physical education, and working as social sports instructors". As a result, colleges and universities employ "cultivating the interdisciplinary talents competent for engaging in sports science research, management of school physical education, and working as social sports instructors" as their training goal for undergraduate PE majors. The expression of the curriculum plan indicates that the cultivation of PE talents places emphasis on the cultivation of the talents associated with physical education, namely, PE teachers who meet the requirements of school physical education, and social sports instructors for public physical fitness, and related talents for theoretical and scientific research. The training goal provides a clear guidance for the curriculum provision and teaching of Physical Education in colleges and universities. Guided by the training goal, colleges and universities have trained a large number of capable PE talents, which has achieved the original intention of the plan.

2.2 The Survey of Employment Whereabouts of PE Major Graduates

In the survey, the author, by visiting the supervisors of career guidance departments of the 5 above-mentioned universities and taking at random 100 employment contracts and other employment proofs of the 2011 PE major graduates from each of the universities, analyzed and sorted out the following statistics(Chart 1). As shown in Chart 1, the employment orientation of PE major graduates demonstrates a diversification trend. The graduates chose to work as PE teachers and sports instructors, to further their studies, to study abroad, to work in national and regional programs, to work in enterprises, public institutions and police force, to work as civil servants, or to

start their own business. This shows that changes have taken place in both the employment concept of the graduates and the social demand of the training types of PE talents, and that the employment channels of the graduates are developing towards diversification.

Chart 1. The Survey of Employment Whereabouts of PE Major Graduates of 5 Universities**(n=500)**

	North China Normal University	Najing Normal University	Fujian Normal University	Huaibei Normal University	Anhui Normal University	Percentage (%)
PE teachers	32	40	35	39	37	36.6
Social sports instructors	21	17	13	11	14	15.2
To pursue master degrees	8	8	9	13	10	9.6
To study abroad	4	3	3	1	2	2.6
National and regional programs	2	5	4	2	3	3.2
Police force	3	3	4	2	2	2.8
Enterprises and public institutions	15	11	12	16	12	13.2
To start their own business	8	7	13	12	13	10.6
Civil servants	4	4	3	2	4	3.4
Others	3	2	4	2	3	2.8
Total	100	100	100	100	100	100

2.3 Analysis of Employment Whereabouts of PE Major Graduates

The talent specifications of the current PE major of our country are mainly such interdisciplinary talents as PE teaching talents, PE research talents, and social sports instructors, and the traditional job market is schools and communities. The result in Chart 1 indicates that the employment orientation of PE major graduates is no longer focusing on PE teachers and social sports instructors, but developing to various positions.

In the traditional employment field, the description of the specific types of the trained talents of PE major, according to the training goal of the curriculum plan, is PE teachers PE teaching talents, PE research talents, and social sports instructors, whose largest job market is schools at all levels and community sports centers. Despite the fact

that 51.8% of the graduates in the survey chose to work as PE teachers and sports instructors, the situation of the oversupply of PE teachers and sports instructors has become the consensus. Although the demand for PE teachers in schools at all levels increased with the government's emphasis on the physical education for students, especially after the promulgation of *The New Curriculum Standards* for primary and secondary schools in 2004, the amount of PE teachers in large and medium-sized cities of our country is tending to be saturated since the human resources market, affected by the transition of our higher education from Elite Education to Mass Education which causes further increase in college enrollment and results in more graduates with each passing year, has transformed from the seller's market to the buyer's market.[2] While social sports instructors, according to *The Second Phase Plan of National Sports-for-All Program(2001—2010)* issued by General Administration of Sport of China which pointed out that after 10 years of hard work, the communities in cities, countryside and towns would generally establish PE guiding stations(centers), and the number of social sports instructor would reach over 650,000, are in great demand. However, considering our country's actual conditions, it is impossible to set up full-time positions for social instructors in the field of mass fitness. [3] The sports instructors are mainly volunteers or part-timers. In other words, the social public welfare sports field does not provide more jobs for PE major graduates. Consequently, few graduates choose to work in social fitness guiding under such circumstances. The situation caused by both the narrow employment prospects for PE major and the considerable increase of the amount of graduates puts more pressure on PE major graduates in getting jobs. Under the above-mentioned situation, PE major graduates, based on the traditional employment prospects, begin to seek other employment opportunities.

48.2% of the graduates in the survey chose to work in the non-traditional fields mainly because of the government's supportive policies, adaptation to social (development) needs and benefit to the realization of self-value. Firstly, in terms of supportive policies, the government issued many policies and measures to solve the employment problem of college graduates under the increasing employment pressure. In 2009, with the aim of ensuring the active support of national policies for the employment of the graduates, the State Council promulgated *Circular of the General Office of the State Council on Enhancing Employment of Regular Institutions of Higher Education* (Guo Ban Fa [2009] No. 3) [4], "encouraging and guiding the graduates to work in grass-root units in urban and rural areas, encouraging the graduates to work in small and medium-sized and non-public enterprises, encouraging and supporting the graduates to be self-employed, strengthening the service and guidance of employment for graduates, and intensifying the employment assistance for the graduates in financial difficulties". Meanwhile, the government took various measures to promote the employment of college graduates by such way as actively guiding the graduates to join the army, to participate in the "three supports and one assistance" plan and to compete for the civil servant posts in the "western plan", and expanding the scale of postgraduate enrollment. These policies and measures did increase the employment choice of the PE major graduates. Secondly, in the way of meeting the social demands, the sport course of our country develops at high speed with the advancement of the overall economic strength and the increase of international exchange. The State Council's promulgation of *The Outline of National Sports-for-All Program* in June

20th, 1995 injected new vitality into the public sports and fitness activities of our country. [5] The first commercialized East Asian Games held in Shanghai in 1993 and the 8th National Games held in Shanghai in 1997 marked the first development of sports marketing industry. The 9th National Games in Guangzhou, which broke the organizing model of previous National Games, first introducing marketing operation mechanism—sponsor system, indicated the formation of sports marketing industry. China's successful staging of the 2008 Beijing Olympic Games symbolized the maturity of the sports marketing industry of our country. [6] In terms of sports sponsorship, the total amount of sponsorship is about 5 billion yuan each year, exceeding the total sum of sports funding of the governments at all levels. [7] Currently, the basic framework of the sports industry of our country has become clear, in which the fitness and entertainment market, the sport competition performance market, the technical training and consultation market, the sports intangible assets management market have developed into the main part of the market, and such related market as the sports lottery market, the sports goods market, the sports advertising market, and the sports tourism market are continuously developing. [8] In 2008, the output value of China's sports industry reached 200 billion yuan, which accounted for 0.69% of China's GDP. Under the circumstance of the rapid development of China's sports industry, great demand for professionals specializing in sports expertise makes it possible for the PE major graduates to work in the industry. Thirdly, in relation to the realization of self-value, the graduates' concept of employment changes with the development of the society. "When the PE major graduates choose their jobs, their value standards tend to be commercialized and their ideals of profession tend to be pragmatic." [10] College students of the new era, who are more distinctive in personality, more innovative and more adventurous, do not observe the old rules and regulations, considering more about highlighting their value of existence. The employment orientation changes with this notion, and the employment prospect shows new changes.

In summary, the employment prospect of the PE major graduates, affected by the stern traditional employment prospect, the changes of their own employment concept, the establishment of awareness of adjusting to the social needs, and the support of the government's employment policies, is becoming diversified, while basing on the traditional employment prospects.

3 Conclusion and Suggestions

3.1 Conclusion

3.1.1 The Diversification Trend of the Employment Orientation of the PE Major Graduates

In the survey, the employment fields of the PE major graduates, on the basis of PE teachers and social sports instructors, expand to the pursuit of master degrees, studying abroad, entering enterprises and public institutions, working in national and regional programs, competing for civil servants posts, and in particular, starting their own business, which has become a new direction of employment of the PE major graduates.

3.1.2 The Certain Limitations of the Training Goal of PE Major

The training goal focuses on cultivating such sports talents as PE teachers, researchers of sports science, and social sports instructors. At the same time, the rapid development of the economy and the sports industry propose new demands. However, the training goal, which does not fully reflect these demands, has certain inapplicability to the social needs.

3.2 Suggestions

3.2.1 Expanding the Training Goal of Talents on the Basis of the Cultivation of PE Talents

The starting point of the existence of PE major is to cultivate PE talents, as well as meet the social demands. The social demands are the premise of the existence and development of the major. Whether the talents trained by the major suit the needs of the society determines the employment situation of the graduates, in a profound level, determines the value of the existence of the major. The major and its trained people are to serve the development of the society. Under the stern employment situation of college graduates of our country, the society puts forward new demands for PE major graduates. Consequently, the diversification of the training goal of PE major not only meets the needs of the society, but also is crucial to the solution to the employment of PE major graduates.

3.2.2 The Transition of the Training Goal from "Uniformity" to "Openness"

Because of the vast area of our country, the economic and social developments of different areas differ greatly, so do the social demands for the sports talents. For example, the nember of the graduates from South China Normal University choosing to work as social sports instructors is greater than that of the graduates from Huaibei Normal University in the economically less developed area. Each university or college firstly consider the needs of local region while cultivating the PE talents. Doing so can not only solve the problem of the employment of the graudates, but also can make contributions to the local economic and social developments. As a result, the transition of the training goal from "uniformity" to "openness" will allow the local colleges and universities to make their own training goal that fits the actual development needs of the local areas so as to make greater contributions to the development of their local areas.

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